

## **DISPOSABLE CLEANING SUBSTRATE**

BY INVENTORS:

BERNARD HILL and NAYMESH PATEL

### **BACKGROUND OF THE INVENTION**

#### **Field of the Invention**

[0001] The present invention relates generally to hard surface cleaning wipes and cleaning pads used by hand or as part of a cleaning implement, such as a mop or bathroom cleaning tool.

#### **Description of the Related Art**

[0002] For many cleaning applications, it is desirable to control the distribution of fibers within a nonwoven substrate. Several types of cleaning wipes, mop pads and pads for other cleaning implements have been developed, for example U.S. Pat. 6,269,513 to Torobin. Several technologies have been developed to provide more abrasive qualities to wipes, for example, U.S. Pat. App. 2002/0132747 to Huyhn et al. and WO2002/071915 to Truong et al. Several technologies have been developed to provide better absorption and strength, for example, WO2000/59439 to Noel et al.

[0003] It is therefore an object of the present invention to control the distribution of fibers and the physical properties of disposable cleaning substrates.

### **SUMMARY OF THE INVENTION**

[0004] In accordance with the above objects and those that will be mentioned and will become apparent below, one aspect of the present invention comprises:

A disposable cleaning substrate comprising:

- a. cellulosic fibers, wherein said cellulosic fibers are present throughout said substrate and wherein said cellulosic fibers vary from less than about 25% on one side of said substrate to greater than about 75% on the other side of said substrate,

- b. thermoplastic fibers of about 2 to 25 denier, wherein said thermoplastic fibers are concentrated on the side of said substrate having lower cellulosic content, and
- c. a binder, wherein said binder comprises binders selected from a group consisting of liquid emulsions, latex binders, liquid adhesives, hot melt polymers, chemical bonding agents, and mixtures thereof.

[0005] In accordance with the above objects and those that will be mentioned and will become apparent below, another aspect of the present invention comprises:

A disposable cleaning substrate comprising:

- a. cellulosic fibers, wherein said cellulosic fibers are present throughout said substrate and wherein said cellulosic fibers vary from less than about 25% on one side of said substrate to greater than about 75% on the other side of said substrate;
- b. thermoplastic fibers of about 2 to 25 denier, wherein said thermoplastic fibers are concentrated on the side of said substrate having lower cellulosic content;
- c. multicomponent fibers, and
- d. a binder, wherein said binder comprises binders selected from a group consisting of liquid emulsions, latex binders, liquid adhesives, chemical bonding agents, and mixtures thereof.

[0006] In accordance with the above objects and those that will be mentioned and will become apparent below, another aspect of the present invention comprises:

A disposable cleaning substrate comprising:

- a. cellulosic fibers, wherein said cellulosic fibers vary from less than about 25% on one side of said substrate to greater than about 75% on the other side of said substrate;
- b. thermoplastic fibers of about 2 to 25 denier, wherein said thermoplastic fibers are concentrated on the side of said substrate having lower cellulosic content;
- c. multicomponent fibers, and

- d. a binder, wherein said binder comprises binders selected from a group consisting of liquid emulsions, latex binders, liquid adhesives, chemical bonding agents, and mixtures thereof.

#### DETAILED DESCRIPTION OF THE INVENTION

[0007] Before describing the present invention in detail, it is to be understood that this invention is not limited to particularly exemplified systems or process parameters that may, of course, vary. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments of the invention only, and is not intended to limit the scope of the invention in any manner.

[0008] All publications, patents and patent applications cited herein, whether *supra* or *infra*, are hereby incorporated by reference in their entirety to the same extent as if each individual publication, patent or patent application was specifically and individually indicated to be incorporated by reference.

[0009] It must be noted that, as used in this specification and the appended claims, the singular forms “a,” “an” and “the” include plural referents unless the content clearly dictates otherwise. Thus, for example, reference to a “surfactant” includes two or more such surfactants.

[0010] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which the invention pertains. Although a number of methods and materials similar or equivalent to those described herein can be used in the practice of the present invention, the preferred materials and methods are described herein.

[0011] In the application, effective amounts are generally those amounts listed as the ranges or levels of ingredients in the descriptions, which follow hereto. Unless otherwise stated, amounts listed in percentage ("%s") are in weight percent (based on 100% active) of the cleaning composition alone, not accounting for the substrate weight. Each of the noted cleaner composition components and substrates is discussed in detail below.

**[0012]** As used herein, the term "cleaning substrate" is intended to include any nonwoven, which is used to clean an article or a surface. Examples of cleaning substrates include, but are not limited to, mitts, wipes which are used to clean a surface by hand, or nonwovens which can be attached to a cleaning implement, such as a floor mop, handle, or a hand held cleaning tool, such as a toilet cleaning device. As used herein, the term "mitt" refers to a covering for the hand having an enclosure that leaves some of the fingers within the same section of the enclosure. The mitt may include space for the thumb in the main enclosure, or provide space for the thumb in a separate enclosure for the thumb, or may not include a thumb enclosure at all. As used herein the term "glove" refers to a covering for the hand having separate sections for each finger.

**[0013]** As used herein, "disposable" is used in its ordinary sense to mean an article that is disposed or discarded after a limited number of usage events, for instance, less than 25, or less than about 10, or less than about 2 entire usage events.

**[0014]** As used herein, "film" refers to a polymer film including flat nonporous films, and porous films such as microporous, nanoporous, closed or open celled, breathable films, or apertured films.

**[0015]** As used herein, "wiping" refers to any shearing action that the substrate undergoes while in contact with a target surface. This includes hand or body motion, substrate-implement motion over a surface, or any perturbation of the substrate via energy sources such as ultrasound, mechanical vibration, electromagnetism, and so forth.

**[0016]** As used herein, the term "fiber" includes both staple fibers, i. e., fibers which have a defined length between about 2 and about 20 mm, fibers longer than staple fiber but are not continuous, and continuous fibers, which are sometimes called "continuous filaments" or simply "filaments". The method in which the fiber is prepared will determine if the fiber is a staple fiber or a continuous filament.

**[0017]** As used herein, the term "nonwoven web" means a web having a structure of individual fibers or threads which are interlaid, but not in an identifiable manner as in a knitted web. Nonwoven webs have been formed from many processes, such as, for example, meltblowing processes, spunbonding processes, and bonded carded web processes. The basis weight of nonwoven webs is usually expressed in ounces of material

per square yard (osy) or grams per square meter (gsm) and the fiber diameters useful are usually expressed in microns, or in the case of staple fibers, denier. It is noted that to convert from osy to gsm, multiply osy by 33.91.

**[0018]** The term "denier" is defined as grams per 9000 meters of a fiber. For a fiber having circular cross-section, denier may be calculated as fiber diameter in microns squared, multiplied by the density in grams/cc, multiplied by 0.00707. A lower denier indicates a finer fiber and a higher denier indicates a thicker or heavier fiber. Outside the United States the unit of measurement is more commonly the "tex," which is defined as the grams per kilometer of fiber. Tex may be calculated as denier/9. The "mean fiber denier" is the sum of the deniers for each fiber, divided by the number of fibers.

**[0019]** As used herein, the term "bulk density" refers to the weight of a material per unit of volume and is generally expressed in units of mass per unit bulk volume (e.g., grams per cubic centimeter).

**[0020]** As used herein, the term "spunbonded fibers" refers to fibers which are formed by extruding molten thermoplastic material as filaments from a plurality of fine, usually circular capillaries of a spinneret with the diameter of the extruded filaments then being rapidly reduced as by, for example, U.S. Pat. No 4,340,563 to Appel et al., and U.S. Pat. No. 3,692,618 to Dorschner et al., U.S. Pat. No. 3,802,817 to Matsuki et al., U.S. Pat. Nos. 3,338,992 and 3,341,394 to Kinney, U.S. Pat. No. 3,502, 763 to Hartman; U.S. Pat. No. 3,542,615 to Dobo et al.; and U.S. Pat. No. 5,382,400 to Pike et al.; the entire content of each is incorporated herein by reference. Spunbond fibers are generally not tacky when they are deposited onto a collecting surface. Spunbond fibers are generally continuous and have average diameters (from a sample of at least 10) larger than 7 microns to about 50 or 60 microns, often, between about 15 and 25 microns.

**[0021]** As used herein, the term "meltblown fibers" means fibers formed by extruding a molten thermoplastic material through a plurality of fine, usually circular, die capillaries as molten threads or filaments into converging high velocity, usually hot, gas (e.g. air) streams which attenuate the filaments of molten thermoplastic material to reduce their diameter, which may be to microfiber diameter. Thereafter, the meltblown fibers are carried by the high velocity gas stream and are deposited on a collecting surface to form a

web of randomly dispersed meltblown fibers. Such a process is disclosed, for example, in U.S. Pat. No. 3,849,241. Meltblown fibers are microfibers, which may be continuous or discontinuous, and are generally smaller than 10 microns in average diameter, and are generally tacky when deposited onto a collecting surface.

**[0022]** As used herein, the term "polymer" generally includes, but is not limited to, homopolymers, copolymers, such as for example, block, graft, random and alternating copolymers, terpolymers, etc. and blends and modifications thereof. Furthermore, unless otherwise specifically limited, the term "polymer" shall include all possible geometrical configurations of the molecule. These configurations include, but are not limited to isotactic, syndiotactic and random symmetries.

**[0023]** As used herein, the term "conjugate fibers" refers to fibers or filaments which have been formed from at least two polymers extruded from separate extruders but spun together to form one fiber. Conjugate fibers are also sometimes referred to as "multicomponent" or "bicomponent" fibers or filaments. The term "bicomponent" means that there are two polymeric components making up the fibers. The polymers are usually different from each other though conjugate fibers may be prepared from the same polymer, but the polymers are different from one another in some physical property, such as, for example, melting point or the softening point. The polymers are arranged in substantially constantly positioned distinct zones across the cross-section of the multicomponent fibers or filaments and extend continuously along the length of the multicomponent fibers or filaments. The configuration of such a multicomponent fiber may be, for example, a sheath/core arrangement, wherein one polymer is surrounded by another, a side-by-side arrangement, a pie arrangement or an "islands-in-the-sea" arrangement. Multicomponent fibers are taught in U.S. Pat. No. 5,108,820 to Kaneko et al., U.S. Pat. No. 5,336,552 to Strack et al., and U.S. Pat. No. 5,382,400 to Pike et al., the entire content of each is incorporated herein by reference. For two component fibers or filaments, the polymers may be present in ratios of 75/25, 50/50, 25/75 or any other desired ratios.

**[0024]** As used herein, the term "multiconstituent fibers" refers to fibers which have been formed from at least two polymers extruded from the same extruder as a blend or mixture. Multiconstituent fibers do not have the various polymer components arranged in relatively

constantly positioned distinct zones across the cross-sectional area of the fiber and the various polymers are usually not continuous along the entire length of the fiber, instead usually forming fibrils or protofibrils which start and end at random.

**[0025]** As used hereing "airlaying" or "airlaid" is a well-known process by which a fibrous nonwoven layer can be formed. In the airlaying process, bundles of small fibers having typical lengths ranging from about 3 to about 52 millimeters (mm) are separated and entrained in an air supply and then deposited onto a forming screen, usually with the assistance of a vacuum supply. The randomly deposited fibers then are bonded to one another using, for example, hot air to activate a binder component or a latex adhesive. Airlaying is taught in, for example, U.S. Pat. No. 4,640,810 to Laursen et al., and U.S. Pat. No. 5,885,516 to Christensen.

**[0026]** As used herein, the term "hot air knife" or HAK means a process of preliminarily bonding a just produced microfiber web, particularly spunbond, in order to give it sufficient integrity, i.e. increase the stiffness of the web, for further processing, but does not mean the relatively strong bonding of secondary bonding processes like through-air bonding, thermal bonding and ultrasonic bonding. A hot air knife is a device which focuses a stream of heated air at a very high flow rate, generally from about 1000 to about 10,000 feet per minute (fpm) (305 to 3050 meters per minute), or more particularly from about 3000 to 6000 feet per minute (915 to 1830 meters per minute) directed at the nonwoven web immediately after the nonwoven web formation. The air temperature is usually in the range of the melting point of at least one of the polymers used in the web, generally between about 200° and 550° F. (93° and 290° C.) for the thermoplastic polymers commonly used in spunbonding. However, the temperature of the air must be adjusted accordingly for the particular polymers used to prepare the nonwoven web. The control of air temperature, velocity, pressure, volume and other factors helps avoid damage to the web while increasing its integrity. The HAK's focused stream of air is arranged and directed by at least one slot of about 1/8 to 1 inches (3 to 25 mm) in width, particularly about 3/8 inch (9.4 mm), serving as the exit for the heated air towards the web, with the slot running in a substantially cross-machine direction over substantially the entire width of the web. In other embodiments, there may be a plurality of slots arranged next to each other or separated by a slight gap. At least one slot is usually, though not

essentially, continuous, and may be comprised of, for example, closely spaced holes. The HAK has a plenum to distribute and contain the heated air prior to its exiting the slot. The plenum pressure of the HAK is usually between about 1.0 and 12.0 inches of water (2 to 22 mmHg), and the HAK is positioned between about 0.25 and 10 inches and more preferably 0.75 to 3.0 inches (19 to 76 mm) above the forming wire. In a particular embodiment the HAK plenum's cross sectional area for cross-directional flow (i.e. the plenum cross sectional area in the machine direction) is at least twice the total slot exit area. Since the forming wire onto which spunbond polymer is formed generally moves at a high rate of speed, the time of exposure of any particular part of the web to the air discharged from the hot air knife is less a tenth of a second and generally about a hundredth of a second in contrast with the through-air bonding process which has a much larger dwell time. The HAK process has a great range of variability and controllability of many factors such as air temperature, velocity, pressure, volume, slot or hole arrangement and size, and the distance from the HAK plenum to the web. The HAK is further described in U.S. Pat. No. 5,707,468 to Arnold et al., the entire contents of which is incorporated by reference.

[0027] As used herein, through-air bonding or "TAB" means a process of bonding a nonwoven fiber web in which air, which is sufficiently hot to melt one of the polymers of which the fibers of the web are made, is forced through the web. The air velocity is between 100 and 500 feet per minute and the dwell time may be as long as 10 seconds. The melting and resolidification of the polymer provides the bonding. Through-air bonding has relatively restricted variability and since through-air bonding requires the melting of at least one component to accomplish bonding, it is generally restricted to webs with two components like multicomponent fibers or those which include an adhesive. In the through-air bonder, air having a temperature above the melting temperature of one component and below the melting temperature of another component is directed from a surrounding hood, through the web, and into a perforated roller supporting the web. Alternatively, the through-air bonder may be a flat arrangement wherein the air is directed vertically downward onto the web. The operating conditions of the two configurations are similar, the primary difference being the geometry of the web during bonding. The hot air melts the lower melting polymer component and thereby forms bonds between the filaments to integrate the web.



**[0028]** As used herein "thermal point bonded" means bonding one or more fabrics with a pattern of discrete bond points. As an example, thermal point bonding often involves passing a fabric or web of fibers to be bonded at a nip between a pair of heated bonding calender rolls. One of the bonding rolls is usually, though not always, patterned in some way so that the entire fabric is not bonded across its entire surface, and the second or anvil roll is usually a smooth surface. As a result, various patterns for calender rolls have been developed for functional as well as aesthetic reasons. One example of a pattern has points and is the Hansen Pennings or "H&P" pattern with about a 30% bond area with about 200 bonds/square inch as taught in U.S. Pat. No. 3,855,046 to Hansen and Pennings. The H&P pattern has square point or pin bonding areas wherein each pin has a side dimension of 0.038 inches (0.965 mm), a spacing of 0.070 inches (1.778 mm) between pins, and a depth of bonding of 0.023 inches (0.584 mm). The resulting pattern has a bonded area of about 29.5%. Another typical point bonding pattern is the expanded Hansen Pennings or "EHP" bond pattern, which produces a 15% bond area with a square pin having a side dimension of 0.037 inches (0.94 mm), a pin spacing of 0.097 inches (2.464 mm) and a depth of 0.039 inches (0.991 mm). Another typical point bonding pattern designated "714" has square pin bonding areas wherein each pin has a side dimension of 0.023 inches, a spacing of 0.062 inches (1.575 mm) between pins, and a depth of bonding of 0.033 inches (0.838 mm). The resulting pattern has a bonded area of about 15%. Yet another common pattern is the C-Star pattern, which has a bond area of about 16.9%. The C-Star pattern has a cross-directional bar or "corduroy" design interrupted by shooting stars. Other common patterns include a diamond pattern with repeating and slightly offset diamonds with about a 16% bond area and a wire weave pattern, having generally alternating perpendicular segments, with about a 19% bond area. Typically, the percent bonding area varies from around 10% to around 30% of the area of the fabric laminate web. Point bonding may be used to hold the layers of a laminate together and/or to impart integrity to individual layers by bonding filaments and/or fibers within the web.

**[0029]** As used herein "pattern unbonded" or interchangeably "point unbonded" or "PUB", means a fabric pattern having continuous bonded areas defining a plurality of discrete unbonded areas. The fibers or filaments within the discrete unbonded areas are dimensionally stabilized by the continuous bonded areas that encircle or surround each unbonded area, such that no support or backing layer of film or adhesive is required. The

unbonded areas are specifically designed to afford spaces between fibers or filaments within the unbonded areas. A suitable process for forming the pattern-unbonded nonwoven material includes providing a nonwoven fabric or web, providing oppositely positioned first and second calender rolls and defining a nip there between, with at least one of said rolls being heated and having a bonding pattern on its outermost surface comprising a continuous pattern of land areas defining a plurality of discrete openings, apertures or holes, and passing the nonwoven fabric or web within the nip formed by said rolls. Each of the openings in said roll or rolls defined by the continuous land areas forms a discrete unbonded area in at least one surface of the nonwoven fabric or web in which the fibers or filaments of the web are substantially or completely unbonded. Stated alternatively, the continuous pattern of land areas in said roll or rolls forms a continuous pattern of bonded areas that define a plurality of discrete unbonded areas on at least one surface of said nonwoven fabric or web. The PUB pattern is further described in U.S. Pat. No. 5,858,515 to Stokes et al, the entire contents of which are hereby incorporated by reference.

[0030] The term "unitized", as used herein, refers to a single structural element. The single structural element may have two or more zones within its distinct outer surfaces exhibiting varying properties. Unitized does not encompass two or more separately manufactured structures that are laminated together.

[0031] The improved disposable cleaning substrate can be used as a disinfectant, sanitizer, and/or sterilizer. As used herein, the term "disinfect" shall mean the elimination of many or all pathogenic microorganisms on surfaces with the exception of bacterial endospores. As used herein, the term "sanitize" shall mean the reduction of contaminants in the inanimate environment to levels considered safe according to public health ordinance, or that reduces the bacterial population by significant numbers where public health requirements have not been established. An at least 99% reduction in bacterial population within a 24 hour time period is deemed "significant." As used herein, the term "sterilize" shall mean the complete elimination or destruction of all forms of microbial life and which is authorized under the applicable regulatory laws to make legal claims as a "Sterilant" or to have sterilizing properties or qualities.

## **Substrate**

**[0032]** The disposable cleaning substrates described herein can be used to clean surfaces in a dry mode, that is, without the use of a cleaning composition. The disposable cleaning substrates described herein can also be used in a wet mode, that is, with pre-applied or concurrently applied cleaning composition.

**[0033]** The hard surface cleaning compositions described herein can be used in a pre-moistened substrate, which can be used to wipe surfaces either alone or in combination with a cleaning implement as described herein. Disposable cleaning substrates include cleaning pads attached to cleaning implements.

**[0034]** In one embodiment, the substrate of the present invention is composed of nonwoven fibers or paper. The term nonwoven is to be defined according to the commonly known definition provided by the "Nonwoven Fabrics Handbook" published by the Association of the Nonwoven Fabric Industry. A paper substrate is defined by EDANA (note 1 of ISO 9092-EN 29092) as a substrate comprising more than 50% by mass of its fibrous content is made up of fibers (excluding chemically digested vegetable fibers) with a length to diameter ratio of greater than 300, and more preferably also has density of less than 0.040 g/cm<sup>3</sup>. The definitions of both nonwoven and paper substrates do not include woven fabric or cloth or sponge. The substrate can be partially or fully permeable to water. The substrate can be flexible and the substrate can be resilient, meaning that once applied external pressure has been removed the substrate regains its original shape.

**[0035]** Film substrate materials may be comprised of polyolefin such as polyethylene, including linear low density polyethylene (LLDPE), low density polyethylene (LDPE), ultra low density polyethylene (ULDPE), high density polyethylene (HDPE), or polypropylene and blends thereof with the above and other materials. Examples of other suitable polymeric materials which may be used include, but are not limited to, polyester, polyurethanes, water-soluble polymers, compostable or biodegradable polymers, heat shrink polymers, thermoplastic elastomers, metallocene catalyst-based polymers (e.g., Insite® available from Dow Chemical and Exxact® available from Exxon), and breathable polymers, apertured film, macroscopically expanded three-dimensional formed films,

foams, filled compositions. As previously discussed, the substrate material may comprise a laminate of one or more elastic layers and one or more non- elastic layers, polymeric films such as thermoplastic films of polyethylene or polypropylene, composite materials such as a film-coated nonwoven material or materials including one or more apertures or apertured regions. Exemplary polyethylene films are manufactured by Clopay Plastic Products Co. of Cincinnati, Ohio under the designation P18- 1401 and by Ethyl Corporation, Visqueen Division, of Terre Haute, Ind., under the designation XP-39385. Substrates in this category include membranes, microporous membranes, natural sponges, synthetic sponges, polymeric netted meshes, formed films, and the like. Exemplary water-soluble polymer films include polyvinyl alcohol, polyethylene oxide, copolymer of vinyl alcohol and poly(oxyene)acrylate, and hydroxypropylcellulose.

[0036] Adhesive substrates can be made with printed binders. For example, a latex binder can be printed in a pattern. Printing can be done by offset printing, gravure printing, flexographic printing, ink jet printing, digital printing of any kind, and the like, with suitable control over temperatures and other characteristics of the printing devices to be compatible with the binder material. Methods for using printed binders are disclosed in U.S. Pat. App. 2003/0135181 to Chen et al.

[0037] Methods of making nonwovens are well known in the art. Generally, these nonwovens can be made by air-laying, water-laying, meltblowing, coforming, spunbonding, or carding processes in which the fibers or filaments are first cut to desired lengths from long strands, passed into a water or air stream, and then deposited onto a screen through which the fiber- laden air or water is passed. The air-laying process is described in U.S. Pat. App. 2003/0036741 to Abba et al. and U.S. Pat. App. 2003/0118825 to Melius et al. The resulting layer, regardless of its method of production or composition, is then subjected to at least one of several types of bonding operations to anchor the individual fibers together to form a self-sustaining substrate. In the present invention the nonwoven substrate can be prepared by a variety of processes including, but not limited to, air-entanglement, hydroentanglement, thermal bonding, and combinations of these processes.

[0038] Additionally, the first layer and the second layer, as well as additional layers, when present, can be bonded to one another in order to maintain the integrity of the article. The

layers can be heat spot bonded together or using heat generated by ultrasonic sound waves. The bonding may be arranged such that geometric shapes and patterns, e.g. diamonds, circles, squares, etc. are created on the exterior surfaces of the layers and the resulting article.

[0039] The bonding pattern can be chosen in order to maximize stiffness of the substrate. This applies in particular when bonding is effected by adhesive (chemical, such as epoxy resin adhesive, or other adhesive) or by ultrasound. Thermal or pressure bonding can be used if the layers to be bonded are appropriate for this. One preferred bonding pattern is application of adhesive or ultrasonic bonding across the full area of the substrate.

Generally such patterns do not take up substantially the entire area, but generally not more than 20%, sometimes not more than 15%, but sometimes at least 5%, of the area of the substrate is covered by bonds.

[0040] One suitable application pattern for adhesive, ultrasonic or other bonds is in the form of a number of stripes extending across the width of the substrate. Preferably the stripes are parallel. The direction can be chosen depending upon the direction in which stiffness is required. For instance, if stiffness in the machine direction (this direction being defined in relation to the manufacturing process for the substrate) is required, i.e. it is required to make folding along a line extending in the transverse direction more difficult, then the stripes can extend in the machine direction. Conversely, if transverse direction stiffness is required, then stripes extending in the transverse direction can be provided.

[0041] A particularly bonding pattern is one of two sets of parallel stripes at different angles, for instance in cross-hatch form. Such systems can provide the effect of introduction of a net between two layers.

[0042] The above patterns for improvement of stiffness are useful when applied to adhesive or ultrasound bonding. However, such patterns can alternatively be applied using hot melt polymer printed onto the substrate, either between layers or on an exterior surface of one of the layers. Such patterns can be applied using any low melting polymer which is flexible after application and drying and capable of producing a continuous film. Suitable polymers include polyethylene. Application of hot melt polymer can be for

instance by screen or gravure printing. Screen printing is preferred. Application of hot melt polymer can be on an exterior surface on one of the layers.

**[0043]** Bonding can be effected after all layers intended to form the substrate have been assembled. In some embodiments, however, two or more layers can be pre-bonded prior to contacting these layers with additional layers to form the substrate.

**[0044]** It is also possible to enhance stiffness of the substrate by means of embossing predetermined patterns onto one or more layers. The patterns are advantageously those discussed above in the context of bonding patterns. Embossing can be achieved by application of the desired pattern under pressure at high or low temperature. Alternatively ultrasound methods can be used for embossing. If any layer is to be embossed, it can be subjected to embossing prior to contact with other layers intended to form the substrate.

**[0045]** The stiffness of the substrate when wet is an important feature. Stiffness is expressed in Taber stiffness units, preferably measured in accordance with ASTM D-5650 (resistance to bending of paper of low bending stiffness). Stiffness of the substrate when dry is measured before it is used for cleaning a surface. Stiffness of the substrate when wet is measured after it has been saturated in water. Stiffness when dry can be at least 5, or at least 8 Taber stiffness units. In particularly cases, stiffness when dry is at least 9 Taber stiffness units. The Taber stiffness when wet can be at least 5 or at least 8. In particular embodiments, the stiffness when wet can be at least 9 Taber stiffness units. Particular embodiments have stiffness when wet at least 50% or at least 60% or at least 80% or at least 90% of stiffness when dry.

**[0046]** The size and shape of the cleaning substrate can vary with respect to the intended application and/or end use of the same. The cleaning substrate can have a substantially rectangular shape of a size, which allows it to readily engage standard cleaning equipment or tools such as, for example, mop heads, duster heads, brush heads and so forth. As one particular example, in order to fit a standard mop head, the cleaning substrate may have a length of about 28 cm and a width of about 22 cm. However, the particular size and/or shape of cleaning substrate can vary as needed to fit upon or otherwise conform to a specific cleaning tool. In an alternative configuration, the cleaning substrate of the present

invention could be formed into a mitten shaped article for wiping and cleaning, which would fit over the users hand.

[0047] The cleaning substrates can be provided dry or pre-moistened. In one aspect, dry cleaning substrates can be provided with dry or substantially dry cleaning or disinfecting agents coated on or in the multicomponent multilobal fiber layer. In addition, the cleaning substrates can be provided in a pre-moistened and/or saturated condition. The wet cleaning substrates can be maintained over time in a sealable container such as, for example, within a bucket with an attachable lid, sealable plastic pouches or bags, canisters, jars, tubs and so forth. Desirably the wet, stacked cleaning substrates are maintained in a resealable container. The use of a resealable container is particularly desirable when using volatile liquid compositions since substantial amounts of liquid can evaporate while using the first substrates thereby leaving the remaining substrates with little or no liquid. Exemplary resealable containers and dispensers include, but are not limited to, those described in U.S. Pat. No. 4,171,047 to Doyle et al., U.S. Pat. No. 4,353,480 to McFadyen, U.S. Pat. No. 4,778,048 to Kaspar et al., U.S. Pat. No. 4,741,944 to Jackson et al., U.S. Pat. No. 5, 595,786 to McBride et al.; the entire contents of each of the aforesaid references are incorporated herein by reference. The cleaning substrates can be incorporated or oriented in the container as desired and/or folded as desired in order to improve ease of use or removal as is known in the art.

[0048] With regard to pre-moistened substrates, a selected amount of liquid is added to the container such that the cleaning substrates contain the desired amount of liquid. Typically, the cleaning substrates are stacked and placed in the container and the liquid subsequently added thereto. The substrate can subsequently be used to wipe a surface as well as act as a vehicle to deliver and apply cleaning liquids to a surface. The moistened and/or saturated cleaning substrates can be used to treat various surfaces. As used herein "treating" surfaces is used in the broad sense and includes, but is not limited to, wiping, polishing, swabbing, cleaning, washing, disinfecting, scrubbing, scouring, sanitizing, and/or applying active agents thereto. The amount and composition of the liquid added to the cleaning substrates will vary with the desired application and/or function of the substrates. As used herein the term "liquid" includes, but is not limited to, solutions, emulsions, suspensions and so forth. Thus, liquids may comprise and/or contain one or more of the following:

disinfectants; antiseptics; diluents; surfactants, such as nonionic, anionic, cationic, waxes; antimicrobial agents; sterilants; sporicides; germicides; bactericides; fungicides; virucides; protozoacides; algicides; bacteriostats; fungistats; virustats; sanitizers; antibiotics; pesticides; and so forth. Numerous cleaning compositions and compounds are known in the art and can be used in connection with the present invention.

**[0049]** The cleaning substrates of the present invention can be provided in a kit form, wherein a plurality of cleaning substrates and a cleaning tool are provided in a single package.

**[0050]** The substrate can include both natural and synthetic fibers. The substrate can be composed of suitable unmodified and/or modified naturally occurring fibers including cotton, Esparto grass, bagasse, hemp, flax, silk, wool, wood pulp, chemically modified wood pulp, jute, ethyl cellulose, and/or cellulose acetate. Various pulp fibers can be utilized including, but not limited to, thermomechanical pulp fibers, chemi-thermomechanical pulp fibers, chemi-mechanical pulp fibers, refiner mechanical pulp fibers, stone groundwood pulp fibers, peroxide mechanical pulp fibers and so forth.

**[0051]** Suitable synthetic fibers can comprise fibers of one, or more, of polyvinyl chloride, polyvinyl fluoride, polytetrafluoroethylene, polyvinylidene chloride, polyacrylics such as ORLON®, polyvinyl acetate, Rayon®, polyethylvinyl acetate, non-soluble or soluble polyvinyl alcohol, polyolefins such as polyethylene (e.g., PULPEX®) and polypropylene, polyamides such as nylon, polyesters such as DACRON® or KODEL®, polyurethanes, polystyrenes, and the like, including fibers comprising polymers containing more than one monomer.

**[0052]** The polymers suitable for the present invention include polyolefins, polyesters, polyamides, polycarbonates, polyurethanes, polyvinylchloride, polytetrafluoroethylene, polystyrene, polyethylene terephthalate, biodegradable polymers such as polylactic acid and copolymers and blends thereof. Suitable polyolefins include polyethylene, e.g., high density polyethylene, medium density polyethylene, low density polyethylene and linear low density polyethylene; polypropylene, e.g., isotactic polypropylene, syndiotactic polypropylene, blends of isotactic polypropylene and atactic polypropylene, and blends thereof; polybutylene, e.g., poly(1-butene) and poly(2-butene); polypentene, e.g., poly(1-



pentene) and poly(2-pentene); poly(3-methyl-1-pentene); poly(4-methyl 1-pentene); and copolymers and blends thereof. Suitable copolymers include random and block copolymers prepared from two or more different unsaturated olefin monomers, such as ethylene/propylene and ethylene/butylene copolymers. Suitable polyamides include nylon 6, nylon 6/6, nylon 4/6, nylon 11, nylon 12, nylon 6/10, nylon 6/12, nylon 12/12, copolymers of caprolactam and alkylene oxide diamine, and the like, as well as blends and copolymers thereof. Suitable polyesters include polyethylene terephthalate, polytrimethylene terephthalate, polybutylene terephthalate, polytetramethylene terephthalate, polycyclohexylene-1,4-dimethylene terephthalate, and isophthalate copolymers thereof, as well as blends thereof.

**[0053]** Many polyolefins are available for fiber production, for example polyethylenes such as Dow Chemical's ASPUN 6811A linear low-density polyethylene, 2553 LLDPE and 25355 and 12350 high density polyethylene are such suitable polymers. The polyethylenes have melt flow rates in g/10 min. at 190° F. and a load of 2.16 kg, of about 26, 40, 25 and 12, respectively. Fiber forming polypropylenes include Exxon Chemical Company's ESCORENE PD3445 polypropylene. Many other polyolefins are commercially available and generally can be used in the present invention. The particularly preferred polyolefins are polypropylene and polyethylene.

**[0054]** Examples of polyamides and their methods of synthesis may be found in "Polymer Resins" by Don E. Floyd (Library of Congress Catalog number 66-20811, Reinhold Publishing, N.Y., 1966). Particularly commercially useful polyamides are nylon 6, nylon-6,6, nylon-11 and nylon-12. These polyamides are available from a number of sources such as Custom Resins, Nyltech, among others. In addition, a compatible tackifying resin may be added to the extrudable compositions described above to provide tackified materials that autogenously bond or which require heat for bonding. Any tackifier resin can be used which is compatible with the polymers and can withstand the high processing (e.g., extrusion) temperatures. If the polymer is blended with processing aids such as, for example, polyolefins or extending oils, the tackifier resin should also be compatible with those processing aids. Generally, hydrogenated hydrocarbon resins are preferred tackifying resins, because of their better temperature stability. REGALREZ® and ARKON® P series tackifiers are examples of hydrogenated hydrocarbon resins.

ZONATAC® 501 lite is an example of a terpene hydrocarbon. REGALREZ® hydrocarbon resins are available from Hercules Incorporated. ARKON® series resins are available from Arakawa Chemical (USA) Incorporated. The tackifying resins such as disclosed in U.S. Pat. No. 4,787,699, hereby incorporated by reference, are suitable. Other tackifying resins which are compatible with the other components of the composition and can withstand the high processing temperatures, can also be used.

[0055] It is desirable that the particular polymers used for the different components of the fibers in the practice of the invention have melting points different from one another. This is important not only in producing crimped fibers but also when through-air bonding is used as the bonding technique, wherein the lower melting polymer bonds the fibers together to form the fabric or web. It is desirable that the lower melting point polymers makes up at least a portion of the outer region of the fibers. More particularly, the lower melting component should be located in an outer portion of the fiber so that it comes in contact with other fibers. For example, in a sheath/core fiber configuration, the lower melting point polymer component should be located in the sheath portion. In a side-by-side configuration, the lower melting point polymer will inherently be located on an outer portion of the fiber.

[0056] The proportion of higher and lower melting polymers in the multicomponent, multilobal fibers can range between about 10-90% by weight higher melting polymer and 10-90% lower melting polymer. In practice, only so much lower melting polymer is needed as will facilitate bonding between the fibers. Thus, a suitable fiber composition may contain about 40-80% by weight higher melting polymer and about 20-60% by weight lower melting polymer, desirably about 50-75% by weight higher melting polymer and about 25-50% by weight lower melting polymer. In one embodiment, a first polymer, which is the lower melting point polymer is polyethylene and the higher melting point polymer is polypropylene.

[0057] The cleaning substrate of this invention may be a multilayer laminate and may be formed by a number of different techniques including but not limited to using adhesive, needle punching, ultrasonic bonding, thermal calendering and through-air bonding. Such a multilayer laminate may be an embodiment wherein some of the layers are spunbond and some meltblown such as a spunbond/meltblown/spunbond (SMS) laminate as

disclosed in U.S. Pat. No. 4,041,203 to Brock et al. and U.S. Pat. No. 5, 169,706 to Collier, et al., each hereby incorporated by reference. The SMS laminate may be made by sequentially depositing onto a moving conveyor belt or forming wire first a spunbond web layer, then a meltblown web layer and last another spunbond layer and then bonding the laminate in a manner described above. Alternatively, the three web layers may be made individually, collected in rolls and combined in a separate bonding step.

**[0058]** The substrate can comprise solely naturally occurring fibers, solely synthetic fibers, or any compatible combination of naturally occurring and synthetic fibers.

**[0059]** The fibers useful herein can be hydrophilic, hydrophobic or can be a combination of both hydrophilic and hydrophobic fibers. As indicated above, the particular selection of hydrophilic or hydrophobic fibers depends upon the other materials included in the absorbent (and to some degree) the scrubbing layer described hereinafter. Suitable hydrophilic fibers for use in the present invention include cellulosic fibers, modified cellulosic fibers, rayon, cotton, and polyester fibers, such as hydrophilic nylon (HYDROFIL®). Suitable hydrophilic fibers can also be obtained by hydrophilizing hydrophobic fibers, such as surfactant-treated or silica-treated thermoplastic fibers derived from, for example, polyolefins such as polyethylene or polypropylene, polyacrylics, polyamides, polystyrenes, polyurethanes and the like.

**[0060]** Another type of hydrophilic fiber for use in the present invention is chemically stiffened cellulosic fibers. As used herein, the term "chemically stiffened cellulosic fibers" means cellulosic fibers that have been stiffened by chemical means to increase the stiffness of the fibers under both dry and aqueous conditions. Such means can include the addition of a chemical stiffening agent that, for example, coats and/or impregnates the fibers. Such means can also include the stiffening of the fibers by altering the chemical structure, e.g., by crosslinking polymer chains.

**[0061]** Where fibers are used as the absorbent layer (or a constituent component thereof), the fibers can optionally be combined with a thermoplastic material. Upon melting, at least a portion of this thermoplastic material migrates to the intersections of the fibers, typically due to interfiber capillary gradients. These intersections become bond sites for the thermoplastic material. When cooled, the thermoplastic materials at these intersections

solidify to form the bond sites that hold the matrix or web of fibers together in each of the respective layers. This can be beneficial in providing additional overall integrity to the cleaning substrate.

[0062] Amongst its various effects, bonding at the fiber intersections increases the overall compressive modulus and strength of the resulting thermally bonded member. In the case of the chemically stiffened cellulosic fibers, the melting and migration of the thermoplastic material also has the effect of increasing the average pore size of the resultant web, while maintaining the density and basis weight of the web as originally formed. This can improve the fluid acquisition properties of the thermally bonded web upon initial exposure to fluid, due to improved fluid permeability, and upon subsequent exposure, due to the combined ability of the stiffened fibers to retain their stiffness upon wetting and the ability of the thermoplastic material to remain bonded at the fiber intersections upon wetting and upon wet compression. In net, thermally bonded webs of stiffened fibers retain their original overall volume, but with the volumetric regions previously occupied by the thermoplastic material becoming open to thus increase the average interfiber capillary pore size.

[0063] Thermoplastic materials useful in the present invention can be in any of a variety of forms including particulates, fibers, or combinations of particulates and fibers. Thermoplastic fibers are a particularly preferred form because of their ability to form numerous interfiber bond sites. Suitable thermoplastic materials can be made from any thermoplastic polymer that can be melted at temperatures that will not extensively damage the fibers that comprise the primary web or matrix of each layer. Preferably, the melting point of this thermoplastic material will be less than about 190° C., and preferably between about 75° C. and about 175° C. In any event, the melting point of this thermoplastic material should be no lower than the temperature at which the thermally bonded absorbent structures, when used in the cleaning pads, are likely to be stored. The melting point of the thermoplastic material is typically no lower than about 50° C.

[0064] The surface of the hydrophobic thermoplastic fiber can be rendered hydrophilic by treatment with a surfactant, such as a nonionic or anionic surfactant, e.g., by spraying the fiber with a surfactant, by dipping the fiber into a surfactant or by including the surfactant as part of the polymer melt in producing the thermoplastic fiber. Upon melting and

resolidification, the surfactant will tend to remain at the surfaces of the thermoplastic fiber. Suitable surfactants include nonionic surfactants such as Brij® 76 manufactured by ICI Americas, Inc. of Wilmington, Delaware, and various surfactants sold under the Pegosperse® trademark by Glyco Chemical, Inc. of Greenwich, Conn. Besides nonionic surfactants, anionic surfactants can also be used. These surfactants can be applied to the thermoplastic fibers at levels of, for example, from about 0.2 to about 1 g per square centimeter of thermoplastic fiber.

[0065] Suitable thermoplastic fibers can be made from a single polymer (monocomponent fibers), or can be made from more than one polymer (e.g., bicomponent or multicomponent fibers). Multicomponent fibers are described in U.S. Pat. App. 2003/0106568 to Keck and Arnold. Bicomponent fibers are described in U.S. Pat. 6,613,704 to Arnold and Myers and references therein. Multicomponent fibers of a wide range of denier or dtex are described in U.S. Pat. App. 2002/0106478 to Hayase et. al. The "bicomponent fibers" may be thermoplastic fibers that comprise a core fiber made from one polymer that is encased within a thermoplastic sheath made from a different polymer. The polymer comprising the sheath often melts at a different, typically lower, temperature than the polymer comprising the core. As a result, these bicomponent fibers provide thermal bonding due to melting of the sheath polymer, while retaining the desirable strength characteristics of the core polymer.

[0066] Suitable bicomponent fibers for use in the present invention can include sheath/core fibers having the following polymer combinations: polyethylene/polypropylene, polyethylvinyl acetate/polypropylene, polyethylene/polyester, polypropylene/polyester, copolyester/polyester, and the like. Particularly suitable bicomponent thermoplastic fibers for use herein are those having a polypropylene or polyester core, and a lower melting copolyester, polyethylvinyl acetate or polyethylene sheath (e.g., those available from Danaklon a/s, Chisso Corp., and CELBOND®, available from Hercules). These bicomponent fibers can be concentric or eccentric. As used herein, the terms "concentric" and "eccentric" refer to whether the sheath has a thickness that is even, or uneven, through the cross-sectional area of the bicomponent fiber. Eccentric bicomponent fibers can be desirable in providing more compressive strength at lower fiber thicknesses.

**[0067]** Methods for preparing thermally bonded fibrous materials are described in U.S. Pat. 5,607,414 to Richards et al. and U.S. Pat. No. 5,549, 589 to Homey et al. The absorbent layer can also comprise a HIPE-derived hydrophilic, polymeric foam. Such foams and methods for their preparation are described in U.S. Pat. No. 5,550,167 to DesMarais and U.S. Pat. 5,563,179 to Stone et al. The disclosures of these references are incorporated by reference herein.

**[0068]** Various forming methods can be used to form a suitable fibrous web. For instance, the web can be made by nonwoven dry forming techniques, such as air-laying, or alternatively by wet laying, such as on a paper making machine. Other non-woven manufacturing techniques, including but not limited to techniques such as melt blown, spunbonded, needle punched, and hydroentanglement methods can also be used. In one embodiment, the dry fibrous web can be an airlaid nonwoven web comprising a combination of natural fibers, staple length synthetic fibers and a latex binder. The dry fibrous web can be about 20- 80 percent by weight wood pulp fibers, 10-60 percent by weight staple length polyester fibers, and about 10-25 percent by weight binder.

**[0069]** The dry, fibrous web can have a basis weight of between about 30 and about 200 grams per square meter. The density of the dry web can be measured after evaporating the liquid from the premoistened wipe, and the density can be less than about 0.15 grams per cubic centimeter. The bulk density is the basis weight of the dry web divided by the thickness of the dry web, measured in consistent units, and the thickness of the dry web is measured using a circular load foot having an area of about 2 square inches and which provides a confining pressure of about 95 grams per square inch. In one embodiment, the dry web can have a basis weight of about 64 grams per square meter, a thickness of about 0.06 cm, and a bulk density of about 0.11 grams per cubic centimeter.

**[0070]** The following patents are incorporated herein by reference for their disclosure related to webs: U.S. Pat. No. 3,862,472; U.S. Pat. No. 3,982,302; U.S. Pat. No. 4,004, 323; U.S. Pat. No. 4,057,669; U. S. Pat. No. 4,097,965; U.S. Pat. No. 4,176,427; U.S. Pat. No. 4,130,915; U.S. Pat. No. 4,135,024; U.S. Pat. No. 4,189,896; U.S. Pat. No. 4,207,367; U.S. Pat. No. 4,296, 161; U.S. Pat. No. 4,309,469; U. S. Pat. No. 4,682,942; U.S. Pat. No. 4,637,859; U.S. Pat. No. 5,223,096; U.S. Pat. No. 5,240,562; U.S. Pat. No. 5,556,509; and U.S. Pat. No. 5,580,423.

**[0071]** In one embodiment, the cleaning substrate has at least two regions where the regions are distinguished by basis weight. Briefly, the measurement is achieved photographically, by differentiating dark (low basis weight) and light (high basis) network regions. In particular, the cleaning substrate comprises one or more low basis weight regions, wherein the low basis region(s) have a basis weight that is not more than about 80% of the basis weight of the high basis weight regions. In one aspect, the first region is relatively high basis weight and comprises an essentially continuous network. The second region comprises a plurality of mutually discrete regions of relatively low basis weight and which are circumscribed by the high basis weight first region. In particular, a cleaning substrate may comprise a continuous region having a basis weight of from about 30 to about 120 grams per square meter and a plurality of discontinuous regions circumscribed by the high basis weight region, wherein the discontinuous regions are disposed in a random, repeating pattern and having a basis weight of not more than about 80% of the basis weight of the continuous region.

**[0072]** In one embodiment, the cleaning substrate will have, in addition to regions which differ with regard to basis weight, substantial macroscopic three-dimensionality. The term "macroscopic three-dimensionality", when used to describe three dimensional cleaning substrates means a three dimensional pattern is readily visible to the naked eye when the perpendicular distance between the viewer's eye and the plane of the substrate is about 12 inches. In other words, the three dimensional structures of the pre-moistened substrates of the present invention are cleaning substrates that are non-planar, in that one or both surfaces of the substrates exist in multiple planes. By way of contrast, the term "planar", refers to substrates having fine-scale surface aberrations on one or both sides, the surface aberrations not being readily visible to the naked eye when the perpendicular distance between the viewer's eye and the plane of the sheet is about 12 inches. In other words, on a macro scale the observer will not observe that one or both surfaces of the substrate will exist in multiple planes so as to be three-dimensional.

**[0073]** Briefly, macroscopic three-dimensionality is described in terms of average height differential, which is defined as the average distance between adjacent peaks and valleys of a given surface of a substrate, as well as the average peak to peak distance, which is the average distance between adjacent peaks of a given surface. Macroscopic three

dimensionality is also described in terms of surface topography index of the outward surface of a cleaning substrate; surface topography index is the ratio obtained by dividing the average height differential of a surface by the average peak to peak distance of that surface. In one embodiment, a macroscopically three-dimensional cleaning substrate has a first outward surface and a second outward surface wherein at least one of the outward surfaces has a peak to peak distance of at least about 1 mm and a surface topography index from about 0.01 mm to about 10 mm. The macroscopically three-dimensional structures of the substrates of the present invention optionally comprise a scrim, which when heated and the cooled, contract so as to provide further macroscopic three-dimensional structure.

[0074] In another embodiment, the substrate can comprise a laminate of two outer hydroentangled webs, such as nonwoven webs of polyester, rayon fibers or blends thereof having a basis weight of about 10 to about 60 grams per square meter, joined to an inner constraining layer, which can be in the form of net like scrim material which contracts upon heating to provide surface texture in the outer layers.

[0075] The pre-moistened substrate can be made by wetting the dry substrate with at least about 1.0 gram of liquid composition per gram of dry fibrous web. The dry substrate can be wetted with at least about 1.5 or at least about 2.0 grams of liquid composition per gram of the dry fibrous web. The exact amount of solution impregnated on the substrate will depend on the product's intended use. For pre-moistened substrates intended to be used for cleaning counter tops, stove tops, glass etc., optimum wetness is from about 1 gram of solution to about 5 grams of solution per gram of substrate. In the context of a floor-cleaning substrate, the pre-moistened substrate can preferably include an absorbent core reservoir with a large capacity to absorb and retain fluid. The absorbent reservoir can have a fluid capacity of from about 5 grams to about 15 grams per gram of absorptive material. Pre-moistened substrates intended to be used for the cleaning of walls, exterior surfaces, etc. will have a capacity of from about 2 grams to about 10 grams of dry fibrous web.

[0076] In addition to using material composition, substrate dimension can also be used to control dosing as well as provide ergonomic appeal. Substrate dimensions are from about 5½ inches to about 9 inches in length, and from about 5½ inches to about 9 inches in width to comfortably fit in a hand. As such, the substrate has dimensions such that the length



and width differ by no more than about 2 inches. In the context of heavier soil cleaning, substrates can be bigger so that they can be used and then folded, either once or twice, so as to contain dirt within the inside of the fold and then the substrate can be re-used.

[0077] In addition to having substrates prepared using a mono-layer substrate, it is advantageous in some situations to have the substrate constructed having multiple layers. In one embodiment, the substrate consists of a multi-laminate structure comprising a pre-moistened outer layer, an impermeable film or membrane inner layer and second outer-layer which is substantially dry. To improve the wet capacity of the substrate and to protect the back layer from getting prematurely wet, an optional absorbent reservoir can be placed between the pre-moistened first outer-layer and the impermeable film or membrane. The dimensions of the reservoir can be smaller than the dimensions of the two outer layers to prevent liquid wicking from the front layer onto the back layer.

[0078] When a multi-laminate structure is used, the outer layer can contain at least about 30% hydrophobic fibers. The impermeable inner layer can be polyethylene, polypropylene or mixtures thereof. The composition mixture and thickness of the impermeable layer can be chosen so as to minimize any seepage of liquid from the pre-moistened first outer-layer to the dry second outer-layer. Those skilled in the art will appreciate that use of a reservoir core or of a high fluid capacity outer-layer will test the impermeable layer, such that more than one impermeable layer can be required to ensure sufficient dryness for the second outer-layer of the substrate. The reservoir, if present, can consist of treated or untreated cellulose, either as a stand alone material or as a hybrid with hydrophobic fibers. The hydrophobic content of the reservoir layer can be less than about 30% or less than about 20% by weight of the total fiber content of the layer. In one embodiment, the reservoir consists of air-laid cellulose. The second outer-layer, which is substantially dry to the touch, can consist of high absorbency cellulose or blends of cellulose and synthetic fibers.

[0079] Chemical bonding utilizes a solvent or adhesive, and U.S. Pat. No. 3,575,749 to Kroyer discloses bonding the fibrous layer with a latex binder, which may be applied to one or both sides of the web. Binders may comprise liquid emulsions, latex binders, liquid adhesives, chemical bonding agents, and mixtures thereof. The binder composition can be made using a latex adhesive commercially available as Rovene 5550 (49 percent solids

styrene butadiene) available from Mallard Creek Polymers of Charlotte, N.C. Other suitable binders are available from National Starch and Chemical, including DUR-O-SET 25-149A ( $T_g = +9^{\circ}\text{C}$ ), NACRYLIC 25-012A ( $T_g = -34^{\circ}\text{C}$ ), NACRYLIC 25-4401 ( $T_g = -23^{\circ}\text{C}$ ), NACRYLIC ABX-30-25331A, RESYN 1072 ( $T_g = +37^{\circ}\text{C}$ ), RESYN 1601, X-LINK 25-033A, DUR-O-SET C310, DUR-O-SET ELITE ULTRA, (vinylacetate homopolymers and copolymers), STRUCTURECOTE 1887(modified starch), NATIONAL 77-1864 ( $T_g = +100^{\circ}\text{C}$ )(modified starch), TYLAC NW-4036-51-9 (styrene-butadiene terpolymer), and from Air Products Polymers, including Flexbond AN214 ( $T_g = +30^{\circ}\text{C}$ )(vinylacetate copolymer). A latex emulsion or solution, typically in an aqueous medium, is applied to one or both surfaces of the web to provide a latex coating which partially impregnates the web, and upon curing stabilizes the structure. The latex may be applied to the web by any suitable means such as spraying, brushing, flooding, rolling, and the like. The amount of latex applied and the degree of penetration of the latex are controlled so as to avoid impairing the effective absorbency.

[0080] The substrate may also contain superabsorbent materials. A wide variety of high absorbency materials (also known as superabsorbent materials) are known to those skilled in the art. See, for example, U.S. Pat. No. 4,076,663 issued Feb. 28, 1978 to Masuda et al, U.S. Pat. No. 4,286,082 issued Aug. 25, 1981 to Tsubakimoto et al., U.S. Pat. No. 4,062,817 issued Dec. 13, 1977 to Westerman, and U.S. Pat. No. 4,340,706 issued Jul. 20, 1982 to Obayashi et al. The absorbent capacity of such high-absorbency materials is generally many times greater than the absorbent capacity of fibrous materials. For example, a fibrous matrix of wood pulp fluff can absorb about 7-9 grams of a liquid, (such as 0.9 weight percent saline) per gram of wood pulp fluff, while the high-absorbency materials can absorb at least about 15, preferably at least about 20, and often at least about 25 grams of liquid, such as 0.9 weight percent saline, per gram of the high-absorbency material. U.S. Pat. No. 5,601,542, issued to Melius et al., discloses an absorbent article in which superabsorbent material is contained in layers of discrete pouches. Alternately, the superabsorbent material may be within one layer or dispersed throughout the substrate.

[0081] The superabsorbent materials can be natural, synthetic, and modified natural polymers and materials. In addition, the superabsorbent materials can be inorganic materials, such as silica gel, or organic compounds such as cross-linked polymers. The

term "cross-linked" refers to any means for effectively rendering normally water-soluble materials substantially water insoluble but swellable. Such means can include, for example, physical entanglement, crystalline domains, covalent bonds, ionic complexes and associations, hydrophilic associations, such as hydrogen bonding, and hydrophobic associations of Van der Waals forces.

[0082] Examples of synthetic superabsorbent material polymers include the alkali metal and ammonium salts of poly(acrylic acid) and poly(methacrylic acid), poly(acrylamides), poly(vinyl ethers), maleic anhydride copolymers with vinyl ethers and alpha-olefins, poly(vinyl pyrrolidone), poly(vinylmorpholinone), poly(vinyl alcohol), and mixtures and copolymers thereof. Further superabsorbent materials include natural and modified natural polymers, such as hydrolyzed acrylonitrile-grafted starch, acrylic acid grafted starch, methyl cellulose, chitosan, carboxymethyl cellulose, hydroxypropyl cellulose, and the natural gums, such as alginates, xanthan gum, locust bean gum and the like. Mixtures of natural and wholly or partially synthetic superabsorbent polymers can also be useful in the present invention. Other suitable absorbent gelling materials are disclosed by Assarsson et al. in U.S. Pat. No. 3,901,236 issued Aug. 26, 1975. Processes for preparing synthetic absorbent gelling polymers are disclosed in U.S. Pat. No. 4,076,663 issued Feb. 28, 1978 to Masuda et al. and U.S. Pat. No. 4,286,082 issued Aug. 25, 1981 to Tsubakimoto et al.

[0083] Superabsorbents may be particulate or fibrous, and are preferably particulate. Superabsorbents are generally available in particle sizes ranging from about 20 to about 1000 microns. Preferred particle sizes range from 100 to 1000 microns. Examples of commercially available particulate superabsorbents include SANWET® IM 3900 and SANWET® IM-5000P, available from Hoescht Celanese located in Portsmouth, Va., DRYTECH® 2035LD available from Dow Chemical Co. located in Midland, Mich., and FAVOR® 880 available from Stockhausen, located in Sweden. FAVOR® 880 is presently preferred because of its high gel strength. An example of a fibrous superabsorbent is OASIS® 101, available from Technical Absorbents, located in Grimsby, United Kingdom.

[0084] The cleaning substrate, upon which the cleaning composition is loaded thereon, is made of an absorbent/adsorbent material. Typically, the cleaning substrate has at least one

layer of nonwoven material. The loading ratio of the cleaning composition onto the cleaning substrate is about 2-5:1, and typically about 3-4:1. The cleaning composition is loaded onto the cleaning substrate in any number of manufacturing methods. Typically, the cleaning substrate is soaked in the cleaning composition for a period of time until the desired amount of loading is achieved.

## **Surfactant**

**[0085]** In one embodiment, the cleaning device comprises a cleaning substrate that is impregnated with a wet surfactant solution. In another embodiment, the cleaning device comprises a cleaning substrate is impregnated with a cleaning composition that is dry-to-the-touch. By 'dry-to-the- touch' it is meant that the substrate is free of water or other solvents in an amount that would make them feel damp or wet to the touch as compared to the touch of a wet substrate. In another embodiment, the cleaning device contains a removable attached vessel containing a cleaning composition and the cleaning substrate is free of the cleaning composition.

**[0086]** The cleaning composition may contain one or more surfactants selected from anionic, nonionic, cationic, ampholytic, amphoteric and zwitterionic surfactants and mixtures thereof. A typical listing of anionic, nonionic, ampholytic, and zwitterionic classes, and species of these surfactants, is given in U.S. Pat. 3,929,678 to Laughlin and Heuring. A list of suitable cationic surfactants is given in U.S. Pat. 4,259,217 to Murphy. Where present, ampholytic, amphoteric and zwitterionic surfactants are generally used in combination with one or more anionic and/or nonionic surfactants. The surfactants may be present at a level of from 0% to 5%, or from 0.001% to 2%, or from 0.01% to 0.5% by weight. Where concentrated cleaning solutions are required, the surfactants may be present at a level of from 5% to 50%, or from 5% to 20%, or from 5% to 10% by weight. Where dry-to-the-touch cleaning solutions are required, the surfactants may be present at a level of from 5% to 100%, or from 10% to 90%, or from 50% to 70% by weight.

**[0087]** The cleaning composition may comprise an anionic surfactant. Essentially any anionic surfactants useful for detergative purposes can be comprised in the cleaning composition. These can include salts (including, for example, sodium, potassium, ammonium, and substituted ammonium salts such as mono-, di- and tri-ethanolamine

salts) of the anionic sulfate, sulfonate, carboxylate and sarcosinate surfactants. Anionic surfactants may comprise a sulfonate or a sulfate surfactant. Anionic surfactants may comprise an alkyl sulfate, a linear or branched alkyl benzene sulfonate, or an alkyldiphenyloxide disulfonate, as described herein.

**[0088]** Other anionic surfactants include the isethionates such as the acyl isethionates, N-acyl taurates, fatty acid amides of methyl tauride, alkyl succinates and sulfosuccinates, monoesters of sulfosuccinate (for instance, saturated and unsaturated C12- C18 monoesters) diesters of sulfosuccinate (for instance saturated and unsaturated C6-C14 diesters), N-acyl sarcosinates. Resin acids and hydrogenated resin acids are also suitable, such as rosin, hydrogenated rosin, and resin acids and hydrogenated resin acids present in or derived from tallow oil. Anionic sulfate surfactants suitable for use herein include the linear and branched primary and secondary alkyl sulfates, alkyl ethoxysulfates, fatty oleoyl glycerol sulfates, alkyl phenol ethylene oxide ether sulfates, the C5-C17acyl-N-(C1-C4 alkyl) and -N-(C1-C2 hydroxyalkyl) glucamine sulfates, and sulfates of alkylpolysacchanides such as the sulfates of alkylpolyglucoside (the nonionic nonsulfated compounds being described herein). Alkyl sulfate surfactants may be selected from the linear and branched primary C10-C18 alkyl sulfates, the C11-C15 branched chain alkyl sulfates, or the C12-C14 linear chain alkyl sulfates.

**[0089]** Alkyl ethoxysulfate surfactants can be selected from the group consisting of the C10-C18 alkyl sulfates which have been ethoxylated with from 0.5 to 20 moles of ethylene oxide per molecule. The alkyl ethoxysulfate surfactant can be a C11-C18, or a C11-C15 alkyl sulfate which has been ethoxylated with from 0.5 to 7, or from 1 to 5, moles of ethylene oxide per molecule. One aspect of the invention employs mixtures of alkyl sulfate and/ or sulfonate and alkyl ethoxysulfate surfactants. Such mixtures have been disclosed in PCT Patent Application No. WO 93/18124.

**[0090]** Anionic sulfonate surfactants suitable for use herein include the salts of C5-C20 linear alkylbenzene sulfonates, alkyl ester sulfonates, C6-C22 primary or secondary alkane sulfonates, C6-C24 olefin sulfonates, sulfonated polycarboxylic acids, alkyl glycerol sulfonates, fatty acyl glycerol sulfonates, fatty oleyl glycerol sulfonates, and any mixtures thereof. Suitable anionic carboxylate surfactants include the alkyl ethoxy carboxylates, the alkyl polyethoxy polycarboxylate surfactants and the soaps ('alkyl carboxyls'),

especially certain secondary soaps as described herein. Suitable alkyl ethoxy carboxylates include those with the formula  $\text{RO}(\text{CH}_2\text{CH}_2\text{O})_x\text{CH}_2\text{COO}^-\text{M}^+$  wherein R is a C6 to C18 alkyl group, x ranges from 0 to 10, and the ethoxylate distribution is such that, on a weight basis, the amount of material where x is 0 is less than 20 % and M is a cation. Suitable alkyl polyethoxypolycarboxylate surfactants include those having the formula  $\text{RO}-(\text{CHR}^1-\text{CHR}^2-\text{O})-\text{R}^3$  wherein R is a C6 to C18 alkyl group, x is from 1 to 25,  $\text{R}^1$  and  $\text{R}^2$  are selected from the group consisting of hydrogen, methyl acid radical, succinic acid radical, hydroxysuccinic acid radical, and mixtures thereof, and  $\text{R}^3$  is selected from the group consisting of hydrogen, substituted or unsubstituted hydrocarbon having between 1 and 8 carbon atoms, and mixtures thereof.

[0091] Suitable soap surfactants include the secondary soap surfactants, which contain a carboxyl unit connected to a secondary carbon. Secondary soap surfactants for use herein include water-soluble members selected from the group consisting of the water-soluble salts of 2-methyl-1-undecanoic acid, 2-ethyl-1-decanoic acid, 2-propyl-1-nonanoic acid, 2-butyl-1-octanoic acid and 2-pentyl-1-heptanoic acid. Certain soaps may also be included as suds suppressors.

[0092] Other suitable anionic surfactants are the alkali metal sarcosinates of formula  $\text{R}-\text{CON}(\text{R}^1)\text{CH}_2\text{COOM}$ , wherein R is a C5-C17 linear or branched alkyl or alkenyl group,  $\text{R}^1$  is a C1-C4 alkyl group and M is an alkali metal ion. Examples are the myristyl and oleoyl methyl sarcosinates in the form of their sodium salts.

[0093] Essentially any alkoxyated nonionic surfactants are suitable herein. The ethoxylated and propoxylated nonionic surfactants are suitable. Alkoxyated surfactants can be selected from the classes of the nonionic condensates of alkyl phenols, nonionic ethoxylated alcohols, nonionic ethoxylated/propoxylated fatty alcohols, nonionic ethoxylate/propoxylate condensates with propylene glycol, and the nonionic ethoxylate condensation products with propylene oxide/ ethylene diamine adducts.

[0094] The condensation products of aliphatic alcohols with from 1 to 25 moles of alkylene oxide, particularly ethylene oxide and/or propylene oxide, are suitable for use herein. The alkyl chain of the aliphatic alcohol can either be straight or branched, primary or secondary, and generally contains from 6 to 22 carbon atoms. Also suitable are the

condensation products of alcohols having an alkyl group containing from 8 to 20 carbon atoms with from 2 to 10 moles of ethylene oxide per mole of alcohol.

[0095] Polyhydroxy fatty acid amides suitable for use herein are those having the structural formula  $R^2CONR^1Z$  wherein:  $R^1$  is H, C1-C4 hydrocarbyl, 2-hydroxyethyl, 2-hydroxypropyl, ethoxy, propoxy, or a mixture thereof, or C1-C4 alkyl, or C1 or C2 alkyl, or C1 alkyl (i.e., methyl); and  $R^2$  is a C5-C31 hydrocarbyl, or straight-chain C5-C19 alkyl or alkenyl, or straight-chain C9-C17 alkyl or alkenyl, or straight-chain C11-C17 alkyl or alkenyl, or mixture thereof, and Z is a polyhydroxyhydrocarbyl having a linear hydrocarbyl chain with at least 3 hydroxyls directly connected to the chain, or an alkoxylated derivative (for example, ethoxylated or propoxylated) thereof. Z can be derived from a reducing sugar in a reductive amination reaction; for example, Z is a glycityl.

[0096] Suitable fatty acid amide surfactants include those having the formula:  $R^1CON(R^2)_2$  wherein  $R^1$  is an alkyl group containing from 7 to 21, or from 9 to 17 carbon atoms and each  $R^2$  is selected from the group consisting of hydrogen, C1-C4 alkyl, C1-C4 hydroxyalkyl, and  $-(C_2H_4O)_xH$ , where x is in the range of from 1 to 3.

[0097] Suitable alkylpolysaccharides for use herein are disclosed in U.S. Pat. 4,565,647 to Llenado, having a hydrophobic group containing from 6 to 30 carbon atoms and a polysaccharide, e.g., a polyglycoside, hydrophilic group containing from 1.3 to 10 saccharide units. Alkylpolyglycosides may have the formula:  $R^2O(C_nH_{2n}O)_t(\text{glycosyl})_x$  wherein  $R^2$  is selected from the group consisting of alkyl, alkylphenyl, hydroxyalkyl, hydroxyalkylphenyl, and mixtures thereof in which the alkyl groups contain from 10 to 18 carbon atoms; n is 2 or 3; t is from 0 to 10, and x is from 1.3 to 8. The glycosyl may be derived from glucose.

[0098] Suitable amphoteric surfactants for use herein include the amine oxide surfactants and the alkyl amphocarboxylic acids. Suitable amine oxides include those compounds having the formula  $R^3(OR^4)_xNO(R^5)_2$  wherein  $R^3$  is selected from an alkyl, hydroxyalkyl, acylamidopropyl and alkylphenyl group, or mixtures thereof, containing from 8 to 26 carbon atoms;  $R^4$  is an alkylene or hydroxyalkylene group containing from 2 to 3 carbon atoms, or mixtures thereof, x is from 0 to 5, preferably from 0 to 3; and each  $R^5$  is an

alkyl or hydroxyalkyl group containing from 1 to 3, or a polyethylene oxide group containing from 1 to 3 ethylene oxide groups. Examples are C10-C18 alkyl dimethylamine oxide, and C10-18 acylamido alkyl dimethylamine oxide. A suitable example of an alkyl amphodicarboxylic acid is Miranol(TM) C2M Conc. manufactured by Miranol, Inc., Dayton, NJ.

[0099] Zwitterionic surfactants can also be incorporated into the detergent compositions in accord with the invention. These surfactants can be broadly described as derivatives of secondary and tertiary amines, derivatives of heterocyclic secondary and tertiary amines, or derivatives of quaternary ammonium, quaternary phosphonium or tertiary sulfonium compounds. Betaine and sultaine surfactants are exemplary zwitterionic surfactants for use herein.

[00100] Suitable betaines are those compounds having the formula  $R(R^1)_2N^+R^2COO^-$  wherein R is a C6-C18 hydrocarbyl group, each  $R^1$  is typically C1-C3 alkyl, and  $R^2$  is a C1-C5 hydrocarbyl group. Examples are C12-18 dimethyl-ammonio hexanoate and the C10-18 acylamidopropane (or ethane) dimethyl (or diethyl) betaines. Complex betaine surfactants are also suitable for use herein.

[00101] Suitable cationic surfactants to be used herein include the quaternary ammonium surfactants. The quaternary ammonium surfactant can be a mono C6-C16, or C6-C10 N-alkyl or alkenyl ammonium surfactants wherein the remaining N positions are substituted by methyl, hydroxyethyl or hydroxypropyl groups. Examples are also the mono-alkoxylated and bis-alkoxylated amine surfactants.

[00102] Another suitable group of cationic surfactants, which can be used in the detergent compositions or components thereof herein, are cationic ester surfactants. The cationic ester surfactant is a, often water dispersible, compound having surfactant properties comprising at least one ester (i.e. -COO-) linkage and at least one cationically charged group. Suitable cationic ester surfactants, including choline ester surfactants, have for example been disclosed in U.S. Pat. No.s 4,228,042, 4,239,660 and 4,260,529. The ester linkage and cationically charged group may be separated from each other in the surfactant molecule by a spacer group consisting of a chain comprising at least three atoms (i.e. of three atoms chain length), or from three to eight atoms, or from three to five atoms,



or three atoms. The atoms forming the spacer group chain are selected from the group consisting, of carbon, nitrogen and oxygen atoms and any mixtures thereof, with the proviso that any nitrogen or oxygen atom in said chain connects only with carbon atoms in the chain. Thus spacer groups having, for example, -O-O- (i.e. peroxide), -N-N-, and -N-O- linkages are excluded, whilst spacer groups having, for example -CH<sub>2</sub>-O-, CH<sub>2</sub>- and -CH<sub>2</sub>-NH-CH<sub>2</sub>- linkages are included. The spacer group chain may comprise only carbon atoms, or the chain is a hydrocarbyl chain.

**[00103]** The cleaning composition may comprise cationic mono-alkoxylated amine surfactants, for instance, of the general formula:  $R^1R^2R^3N^+ApR^4X^-$  wherein  $R^1$  is an alkyl or alkenyl moiety containing from about 6 to about 18 carbon atoms, or from 6 to about 16 carbon atoms, or from about 6 to about 14 carbon atoms;  $R^2$  and  $R^3$  are each independently alkyl groups containing from one to about three carbon atoms, for instance, methyl, for instance, both  $R^2$  and  $R^3$  are methyl groups;  $R^4$  is selected from hydrogen, methyl and ethyl;  $X^-$  is an anion such as chloride, bromide, methylsulfate, sulfate, or the like, to provide electrical neutrality; A is an alkoxy group, especially an ethoxy, propoxy or butoxy group; and p is from 0 to about 30, or from 2 to about 15, or from 2 to about 8. The  $ApR^4$  group in the formula may have p=1 and is a hydroxyalkyl group, having no greater than 6 carbon atoms whereby the -OH group is separated from the quaternary ammonium nitrogen atom by no more than 3 carbon atoms. Suitable  $ApR^4$  groups are -CH<sub>2</sub>CH<sub>2</sub>-OH, -CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>-OH, -CH<sub>2</sub>CH(CH<sub>3</sub>)-OH and -CH(CH<sub>3</sub>)CH<sub>2</sub>-OH. Suitable  $R^1$  groups are linear alkyl groups, for instance, linear  $R^1$  groups having from 8 to 14 carbon atoms.

**[00104]** Suitable cationic mono-alkoxylated amine surfactants for use herein are of the formula  $R^1(CH_3)(CH_3)N^+(CH_2CH_2O)_{2-5}H X^-$  wherein  $R^1$  is C10-C18 hydrocarbyl and mixtures thereof, especially C10-C14 alkyl, or C10 and C12 alkyl, and X is any convenient anion to provide charge balance, for instance, chloride or bromide.

**[00105]** As noted, compounds of the foregoing type include those wherein the ethoxy (CH<sub>2</sub>CH<sub>2</sub>O) units (EO) are replaced by butoxy, isopropoxy [CH(CH<sub>3</sub>)CH<sub>2</sub>O] and [CH<sub>2</sub>CH(CH<sub>3</sub>)O] units (i-Pr) or n-propoxy units (Pr), or mixtures of EO and/or Pr and/or i-Pr units.

**[00106]** The cationic bis-alkoxylated amine surfactant may have the general formula:  $R^1R^2N^+ApR^3A'qR^4X^-$  wherein  $R^1$  is an alkyl or alkenyl moiety containing from about 8 to about 18 carbon atoms, or from 10 to about 16 carbon atoms, or from about 10 to about 14 carbon atoms;  $R^2$  is an alkyl group containing from one to three carbon atoms, for instance, methyl;  $R^3$  and  $R^4$  can vary independently and are selected from hydrogen, methyl and ethyl,  $X^-$  is an anion such as chloride, bromide, methylsulfate, sulfate, or the like, sufficient to provide electrical neutrality. A and A' can vary independently and are each selected from C1-C4 alkoxy, for instance, ethoxy, (i.e.,  $-CH_2CH_2O-$ ), propoxy, butoxy and mixtures thereof, p is from 1 to about 30, or from 1 to about 4 and q is from 1 to about 30, or from 1 to about 4, or both p and q are 1.

**[00107]** Suitable cationic bis-alkoxylated amine surfactants for use herein are of the formula  $R^1CH_3N^+(CH_2CH_2OH)(CH_2CH_2OH)X^-$ , wherein  $R^1$  is C10-C18 hydrocarbyl and mixtures thereof, or C10, C12, C14 alkyl and mixtures thereof,  $X^-$  is any convenient anion to provide charge balance, for example, chloride. With reference to the general cationic bis-alkoxylated amine structure noted above, since in one example compound  $R^1$  is derived from (coconut) C12-C14 alkyl fraction fatty acids,  $R^2$  is methyl and  $ApR^3$  and  $A'qR^4$  are each monoethoxy.

**[00108]** Other cationic bis-alkoxylated amine surfactants useful herein include compounds of the formula:  $R^1R^2N^+-(CH_2CH_2O)_pH-(CH_2CH_2O)_qH X^-$  wherein  $R^1$  is C10-C18 hydrocarbyl, or C10-C14 alkyl, independently p is 1 to about 3 and q is 1 to about 3,  $R^2$  is C1-C3 alkyl, for example, methyl, and  $X^-$  is an anion, for example, chloride or bromide.

**[00109]** Other compounds of the foregoing type include those wherein the ethoxy  $(CH_2CH_2O)$  units (EO) are replaced by butoxy (Bu) isopropoxy  $[CH(CH_3)CH_2O]$  and  $[CH_2CH(CH_3)O]$  units (i-Pr) or n-propoxy units (Pr), or mixtures of EO and/or Pr and/or i-Pr units.

**[00110]** The inventive compositions may include at least one fluorosurfactant selected from nonionic fluorosurfactants, cationic fluorosurfactants, and mixtures thereof which are soluble in the aqueous compositions being taught herein, particularly compositions which do not include further deterative surfactants, or further organic

solvents, or both. Useful nonionic fluorosurfactant compounds are found among the materials presently commercially marketed under the tradename Fluorad® (ex. 3M Corp.) Exemplary useful fluorosurfactants include those sold as Fluorad® FC-740, generally described to be fluorinated alkyl esters; Fluorad® FC-430, generally described to be fluorinated alkyl esters; Fluorad® FC-431, generally described to be fluorinated alkyl esters; and, Fluorad® FC-170-C, which is generally described as being fluorinated alkyl polyoxyethylene ethanols.

[00111] Suitable nonionic fluorosurfactant compounds include those which is believed to conform to the following formulation:  $C_nF_{2n+1}SO_2N(C_2H_5)(CH_2CH_2O)_xCH_3$  wherein: n has a value of from 1-12, or from 4-12, or 8; x has a value of from 4-18, or from 4-10, or 7; which is described to be a nonionic fluorinated alkyl alkoxylate and which is sold as Fluorad® FC-171 (ex. 3M Corp., formerly Minnesota Mining and Manufacturing Co.).

[00112] Additionally useful nonionic fluorosurfactant compounds are also found among the materials marketed under the tradename ZONYL® (DuPont Performance Chemicals). These include, for example, ZONYL® FSO and ZONYL® FSN. These compounds have the following formula:  $RfCH_2CH_2O(CH_2CH_2O)_xH$  where Rf is  $F(CF_2CF_2)_y$ . For ZONYL® FSO, x is 0 to about 15 and y is 1 to about 7. For ZONYL® FSN, x is 0 to about 25 and y is 1 to about 9.

[00113] An example of a useful cationic fluorosurfactant compound has the following structure:  $C_nF_{2n+1}SO_2NHC_3H_6N^+(CH_3)_3I^-$  where  $n \sim 8$ . This cationic fluorosurfactant is available under the tradename Fluorad® FC-135 from 3M. Another example of a useful cationic fluorosurfactant is  $F_3-(CF_2)_n-(CH_2)_mSCH_2CHOH-CH_2-N^+R_1R_2R_3Cl^-$  wherein: n is 5-9 and m is 2, and  $R_1$ ,  $R_2$  and  $R_3$  are  $-CH_3$ . This cationic fluorosurfactant is available under the tradename ZONYL® FSD (available from DuPont, described as 2-hydroxy-3-((gamma-omega-perfluoro-  $C_{6-20}$ -alkyl)thio)-N,N,N-trimethyl-1-propyl ammonium chloride). Other cationic fluorosurfactants suitable for use in the present invention are also described in EP 866,115 to Leach and Niwata.

[00114] The fluorosurfactant selected from the group of nonionic fluorosurfactant, cationic fluorosurfactant, and mixtures thereof may be present in amounts of from 0.001 to 5% wt., or from 0.01 to 1% wt., or from 0.01 to 0.5% wt.

#### **Solvent**

[00115] Suitable organic solvents include, but are not limited to, C<sub>1-6</sub> alkanols, C<sub>1-6</sub> diols, C<sub>1-10</sub> alkyl ethers of alkylene glycols, C<sub>3-24</sub> alkylene glycol ethers, polyalkylene glycols, short chain carboxylic acids, short chain esters, isoparafinic hydrocarbons, mineral spirits, alkylaromatics, terpenes, terpene derivatives, terpenoids, terpenoid derivatives, formaldehyde, and pyrrolidones. Alkanols include, but are not limited to, methanol, ethanol, n-propanol, isopropanol, butanol, pentanol, and hexanol, and isomers thereof. Diols include, but are not limited to, methylene, ethylene, propylene and butylene glycols. Alkylene glycol ethers include, but are not limited to, ethylene glycol monopropyl ether, ethylene glycol monobutyl ether, ethylene glycol monohexyl ether, diethylene glycol monopropyl ether, diethylene glycol monobutyl ether, diethylene glycol monohexyl ether, propylene glycol methyl ether, propylene glycol ethyl ether, propylene glycol n-propyl ether, propylene glycol monobutyl ether, propylene glycol t-butyl ether, di- or tri-polypropylene glycol methyl or ethyl or propyl or butyl ether, acetate and propionate esters of glycol ethers. Short chain carboxylic acids include, but are not limited to, acetic acid, glycolic acid, lactic acid and propionic acid. Short chain esters include, but are not limited to, glycol acetate, and cyclic or linear volatile methylsiloxanes. Water insoluble solvents such as isoparafinic hydrocarbons, mineral spirits, alkylaromatics, terpenoids, terpenoid derivatives, terpenes, and terpenes derivatives can be mixed with a water soluble solvent when employed.

[00116] Examples of organic solvent having a vapor pressure less than 0.1 mm Hg (20° C) include, but are not limited to, dipropylene glycol n-propyl ether, dipropylene glycol t-butyl ether, dipropylene glycol n-butyl ether, tripropylene glycol methyl ether, tripropylene glycol n-butyl ether, diethylene glycol propyl ether, diethylene glycol butyl ether, dipropylene glycol methyl ether acetate, diethylene glycol ethyl ether acetate, and diethylene glycol butyl ether acetate (all available from ARCO Chemical Company).

**[00117]** The solvents can be present at a level of from 0.001% to 10%, or from 0.01% to 10%, or from 1% to 4% by weight.

#### **Additional adjuncts**

**[00118]** The cleaning compositions optionally contain one or more of the following adjuncts: stain and soil repellants, lubricants, odor control agents, perfumes, fragrances and fragrance release agents, and bleaching agents. Other adjuncts include, but are not limited to, acids, electrolytes, dyes and/or colorants, solubilizing materials, stabilizers, thickeners, defoamers, hydrotropes, cloud point modifiers, preservatives, and other polymers. The solubilizing materials, when used, include, but are not limited to, hydrotropes (e.g. water soluble salts of low molecular weight organic acids such as the sodium and/or potassium salts of toluene, cumene, and xylene sulfonic acid). The acids, when used, include, but are not limited to, organic hydroxy acids, citric acids, keto acid, and the like. Electrolytes, when used, include, calcium, sodium and potassium chloride. Thickeners, when used, include, but are not limited to, polyacrylic acid, xanthan gum, calcium carbonate, aluminum oxide, alginates, guar gum, methyl, ethyl, clays, and/or propyl hydroxycelluloses. Defoamers, when used, include, but are not limited to, silicones, aminosilicones, silicone blends, and/or silicone/ hydrocarbon blends. Bleaching agents, when used, include, but are not limited to, peracids, hypohalite sources, hydrogen peroxide, and/or sources of hydrogen peroxide.

**[00119]** Preservatives, when used, include, but are not limited to, mildewstat or bacteriostat, methyl, ethyl and propyl parabens, short chain organic acids (e.g. acetic, lactic and/or glycolic acids), bisguanidine compounds (e.g. Dantagard and/or Glydant) and/or short chain alcohols (e.g. ethanol and/or IPA). The mildewstat or bacteriostat includes, but is not limited to, mildewstats (including non-isothiazolone compounds) include Kathon GC, a 5-chloro-2-methyl-4-isothiazolin-3-one, KATHON ICP, a 2-methyl-4-isothiazolin-3-one, and a blend thereof, and KATHON 886, a 5-chloro-2-methyl-4-isothiazolin-3-one, all available from Rohm and Haas Company; BRONOPOL, a 2-bromo-2-nitropropane 1, 3 diol, from Boots Company Ltd., PROXEL CRL, a propyl-p-hydroxybenzoate, from ICI PLC; NIPASOL M, an o-phenyl-phenol, Na<sup>+</sup> salt, from Nipa Laboratories Ltd., DOWICIDE A, a 1,2-Benzisothiazolin-3-one, from Dow Chemical

Co., and IRGASAN DP 200, a 2,4,4'-trichloro-2-hydroxydiphenylether, from Ciba-Geigy A.G.

### **Antimicrobial Agent**

[00120] Antimicrobial agents include quaternary ammonium compounds and phenolics. Non-limiting examples of these quaternary compounds include benzalkonium chlorides and/or substituted benzalkonium chlorides, di(C<sub>6</sub>-C<sub>14</sub>)alkyl di short chain (C<sub>1-4</sub> alkyl and/or hydroxyalkyl) quaternary ammonium salts, N-(3-chloroallyl) hexaminium chlorides, benzethonium chloride, methylbenzethonium chloride, and cetylpyridinium chloride. Other quaternary compounds include the group consisting of dialkyldimethyl ammonium chlorides, alkyl dimethylbenzylammonium chlorides, dialkylmethylbenzylammonium chlorides, and mixtures thereof. Biguanide antimicrobial actives including, but not limited to polyhexamethylene biguanide hydrochloride, p-chlorophenyl biguanide; 4-chlorobenzhydryl biguanide, halogenated hexidine such as, but not limited to, chlorhexidine (1,1'-hexamethylene -bis-5-(4-chlorophenyl biguanide) and its salts are also in this class.

### **Builder/Buffer**

[00121] The cleaning composition may include a builder or buffer, which increase the effectiveness of the surfactant. The builder or buffer can also function as a softener and/or a sequestering agent in the cleaning composition. A variety of builders or buffers can be used and they include, but are not limited to, phosphate-silicate compounds, zeolites, alkali metal, ammonium and substituted ammonium polyacetates, trialkali salts of nitrilotriacetic acid, carboxylates, polycarboxylates, carbonates, bicarbonates, polyphosphates, aminopolycarboxylates, polyhydroxysulfonates, and starch derivatives.

[00122] Builders or buffers can also include polyacetates and polycarboxylates. The polyacetate and polycarboxylate compounds include, but are not limited to, sodium, potassium, lithium, ammonium, and substituted ammonium salts of ethylenediamine tetraacetic acid, ethylenediamine triacetic acid, ethylenediamine tetrapropionic acid, diethylenetriamine pentaacetic acid, nitrilotriacetic acid, oxydisuccinic acid, iminodisuccinic acid, mellitic acid, polyacrylic acid or polymethacrylic acid and copolymers, benzene polycarboxylic acids, gluconic acid, sulfamic acid, oxalic acid,

phosphoric acid, phosphonic acid, organic phosphonic acids, acetic acid, and citric acid. These builders or buffers can also exist either partially or totally in the hydrogen ion form.

**[00123]** The builder agent can include sodium and/or potassium salts of EDTA and substituted ammonium salts. The substituted ammonium salts include, but are not limited to, ammonium salts of methylamine, dimethylamine, butylamine, butylenediamine, propylamine, triethylamine, trimethylamine, monoethanolamine, diethanolamine, triethanolamine, isopropanolamine, ethylenediamine tetraacetic acid and propanolamine.

**[00124]** Buffering and pH adjusting agents, when used, include, but are not limited to, organic acids, mineral acids, alkali metal and alkaline earth salts of silicate, metasilicate, polysilicate, borate, hydroxide, carbonate, carbamate, phosphate, polyphosphate, pyrophosphates, triphosphates, tetraphosphates, ammonia, hydroxide, monoethanolamine, monopropanolamine, diethanolamine, dipropanolamine, triethanolamine, and 2-amino-2-methylpropanol. Some examples are amino acids such as lysine or lower alcohol amines like mono-, di-, and tri-ethanolamine. Other nitrogen-containing buffering agents are tri(hydroxymethyl) amino methane (TRIS), 2-amino-2-ethyl-1,3-propanediol, 2-amino-2-methyl- propanol, 2- amino-2-methyl-1,3-propanol, disodium glutamate, N-methyl diethanolamide, 2-dimethylamino- 2-methylpropanol (DMAMP), 1,3-bis(methylamine)-cyclohexane, 1,3-diamino-propanol N,N'- tetra-methyl-1,3-diamino-2-propanol, N,N-bis(2-hydroxyethyl)glycine (bicine) and N-tris(hydroxymethyl)methyl glycine (tricine). Other suitable buffers include ammonium carbamate, citric acid, acetic acid. Mixtures of any of the above are also acceptable. Useful inorganic buffers/alkalinity sources include ammonia, the alkali metal carbonates and alkali metal phosphates, e.g., sodium carbonate, sodium polyphosphate. For additional buffers see WO 95/07971, which is incorporated herein by reference. Other preferred pH adjusting agents include sodium or potassium hydroxide.

**[00125]** When employed, the builder, buffer, or pH adjusting agent comprises at least about 0.001% and typically about 0.01-5% of the cleaning composition. In one example, the builder or buffer content is about 0.01-2%.

## **Pine oil, terpene derivatives and essential oils**

**[00126]** Compositions according to the invention may comprise pine oil, terpene derivatives and/or essential oils. Pine oil, terpene derivatives and essential oils are used primarily for cleaning efficacy. They may also provide some antimicrobial efficacy and deodorizing properties. Pine oil, terpene derivatives and essential oils may be present in the compositions in amounts of up to about 1% by weight, or in amounts of 0.01% to 0.5% by weight.

**[00127]** Pine oil is a complex blend of oils, alcohols, acids, esters, aldehydes and other organic compounds. These include terpenes which include a large number of related alcohols or ketones. Some important constituents include terpineol. One type of pine oil, synthetic pine oil, will generally contain a higher content of turpentine alcohols than the two other grades of pine oil, namely steam distilled and sulfate pine oils. Other important compounds include alpha- and beta- pinene (turpentine), abietic acid (rosin), and other isoprene derivatives. Particularly effective pine oils are commercially available from Mellennium Chemicals, under the Glidco tradename. These pine oils vary in the amount of terpene alcohols and alpha-terpineol.

**[00128]** Terpene derivatives appropriate for use in the inventive composition include terpene hydrocarbons having a functional group, such as terpene alcohols, terpene ethers, terpene esters, terpene aldehydes and terpene ketones. Examples of suitable terpene alcohols include verbenol, transpinocarveol, cis-2-pinanol, nopol, isoborneol, carbeol, piperitol, thymol, alpha-terpineol, terpinen-4-ol, menthol, 1,8-terpin, dihydro-terpineol, nerol, geraniol, linalool, citronellol, hydroxycitronellol, 3, 7-dimethyl octanol, dihydro-myrcenol, tetrahydro-alloocimenol, perillalcohol, and falcariindiol. Examples of suitable terpene ether and terpene ester solvents include 1,8-cineole, 1,4-cineole, isobornyl methylether, rose pyran, menthofuran, trans-anethole, methyl chavicol, allocimene diepoxide, limonene mono-epoxide, isobornyl acetate, nonyl acetate, terpinyl acetate, linalyl acetate, geranyl acetate, citronellyl acetate, dihydro-terpinyl acetate and meryl acetate. Further, examples of suitable terpene aldehyde and terpene ketone solvents include myrtenal, campholenic aldehyde, perillaldehyde, citronellal, citral, hydroxy citronellal, camphor, verbenone, carvenone, dihydro-carvone, carvone, piperitone,



menthone, geranyl acetone, pseudo- ionone, ionine, iso-pseudo-methyl ionone, n-pseudo-methyl ionone, iso-methyl ionone and n-methyl ionone.

**[00129]** Essential oils include, but are not limited to, those obtained from thyme, lemongrass, citrus, lemons, oranges, anise, clove, aniseed, pine, cinnamon, geranium, roses, mint, lavender, citronella, eucalyptus, peppermint, camphor, sandalwood, rosmarin, vervain, fleagrass, lemongrass, ratanhia, cedar and mixtures thereof. Actives of essential oils to be used herein include, but are not limited to, thymol (present for example in thyme), eugenol (present for example in cinnamon and clove), menthol (present for example in mint), geraniol (present for example in geranium and rose), verbenone (present for example in vervain), eucalyptol and pinocarvone (present in eucalyptus), cedrol (present for example in cedar), anethol (present for example in anise), carvacrol, hinokitiol, berberine, ferulic acid, cinnamic acid, methyl salicylic acid, methyl salicylate, terpineol and mixtures thereof. Examples of actives of essential oils to be used herein are thymol, eugenol, verbenone, eucalyptol, terpineol, cinnamic acid, methyl salicylic acid, citric acid and/or geraniol.

**[00130]** Other essential oils include Anethole 20/21 natural, Aniseed oil china star, Aniseed oil globe brand, Balsam (Peru), Basil oil (India), Black pepper oil, Black pepper oleoresin 40/20, Bois de Rose (Brazil) FOB, Borneol Flakes (China), Camphor oil, White, Camphor powder synthetic technical, Canaga oil (Java), Cardamom oil, Cassia oil (China), Cedarwood oil (China) BP, Cinnamon bark oil, Cinnamon leaf oil, Citronella oil, Clove bud oil, Clove leaf, Coriander (Russia), Coumarin 69.degree. C. (China), Cyclamen Aldehyde, Diphenyl oxide, Ethyl vanilin, Eucalyptol, Eucalyptus oil, Eucalyptus citriodora, Fennel oil, Geranium oil, Ginger oil, Ginger oleoresin (India), White grapefruit oil, Guaiacwood oil, Gurjun balsam, Heliotropin, Isobomyl acetate, Isolongifolene, Juniper berry oil, L-methhyl acetate, Lavender oil, Lemon oil, Lemongrass oil, Lime oil distilled, Litsea Cubeba oil, Longifolene, Menthol crystals, Methyl cedryl ketone, Methyl chavicol, Methyl salicylate, Musk ambrette, Musk ketone, Musk xylol, Nutmeg oil, Orange oil, Patchouli oil, Peppermint oil, Phenyl ethyl alcohol, Pimento berry oil, Pimento leaf oil, Rosalin, Sandalwood oil, Sandenol, Sage oil, Clary sage, Sassafras oil, Spearmint oil, Spike lavender, Tagetes, Tea tree oil, Vanilin, Vetyver oil (Java), Wintergreen. Each of these botanical oils is commercially available.

**[00131]** Oils include peppermint oil, lavender oil, bergamot oil (Italian), rosemary oil (Tunisian), and sweet orange oil. These may be commercially obtained from a variety of suppliers including: Givadan Roure Corp. (Clifton, N.J.); Berje Inc. (Bloomfield, N.J.); BBA Aroma Chemical Div. of Union Camp Corp. (Wayne, N.J.); Firmenich Inc. (Plainsboro N.J.); Quest International Fragrances Inc. (Mt. Olive Township, N.J.); Robertet Fragrances Inc. (Oakland, N.J.).

**[00132]** Particularly useful lemon oil and d-limonene compositions which are useful in the invention include mixtures of terpene hydrocarbons obtained from the essence of oranges, e.g., cold-pressed orange terpenes and orange terpene oil phase ex fruit juice, and the mixture of terpene hydrocarbons expressed from lemons and grapefruit.

### **Polymers**

**[00133]** Polymeric material that improves the hydrophilicity of the surface being treated can be incorporated into the present compositions. The increase in hydrophilicity provides improved final appearance by providing "sheeting" of the water from the surface and/or spreading of the water on the surface, and this effect is preferably seen when the surface is rewetted and even when subsequently dried after the rewetting. Polymer substantivity is beneficial as it prolongs the sheeting and cleaning benefits. Another important feature of preferred polymers is lack of visible residue upon drying. In embodiments, the polymer comprises 0.001 to 5%, or 0.01 to 1%, or 0.1 to 0.5% of the cleaning composition.

**[00134]** In general, the aqueous polymer containing composition may comprise a water soluble or water dispersible polymer. The hydrophilic polymers preferably are attracted to surfaces and are absorbed thereto without covalent bonds. Examples of suitable polymers include the polymers and co-polymers of N,N dimethyl acrylamide, acrylamide, and certain monomers containing quaternary ammonium groups or amphoteric groups that favor substantivity to surfaces, along with co-monomers that favor adsorption of water, such as, for example, acrylic acid and other acrylate salts, sulfonates, betaines, and ethylene oxides.

**[00135]** With respect to the synthesis of the water soluble or water dispersible cationic copolymer, the level of the first monomer, which has a permanent cationic charge

or that is capable of forming a cationic charge on protonation, is typically between 3 and 80 mol% and preferably 10 to 60 mol% of the copolymer. The level of second monomer, which is an acidic monomer that is capable of forming an anionic charge in the composition, when present is typically between 3 and 80 mol %, or 10 to 60 mol % of the copolymer. The level of the third monomer, which has an uncharged hydrophilic group, when present is typically between 3 and 80 mol %, or 10 to 60 mol% of the copolymer. When present, the level of uncharged hydrophobic monomer is less than about 50 mol %, or less than 10 mol % of the copolymer. The molar ratio of the first monomer to the second monomer typically ranges from 19:1 to 1:10, or ranges from 9:1 to 1:6. The molar ratio of the first monomer to the third monomer is typically ranges from 4:1 to 1:4, or ranges from 2:1 to 1:2.

**[00136]** The average molecular weight of the copolymer typically ranges from about 5,000 to about 10,000,000, with the preferred molecular weight range depending on the polymer composition with the proviso that the molecular weight is selected so that the copolymer is water soluble or water dispersible to at least 0.01% by weight in distilled water at 25°C.

**[00137]** Examples of permanently cationic monomers include, but are not limited to, quaternary ammonium salts of substituted acrylamide, methacrylamide, acrylate and methacrylate, such as trimethylammoniummethacrylate, trimethylammoniumpropylmethacrylamide, trimethylammoniummethacrylate, trimethylammoniumpropylacrylamide, 2-vinyl N-alkyl quaternary pyridinium, 4-vinyl N-alkyl quaternary pyridinium, 4-vinylbenzyltrialkylammonium, 2-vinyl piperidinium, 4-vinyl piperidinium, 3-alkyl 1-vinyl imidazolium, diallyldimethylammonium, and the ionene class of internal cationic monomers as described by D. R. Berger in *Cationic Surfactants, Organic Chemistry*, edited by J. M. Richmond, Marcel Dekker, New York, 1990, ISBN 0-8247-8381-6, which is incorporated herein by reference. This class includes co-poly ethylene imine, co-poly ethoxylated ethylene imine and co-poly quaternized ethoxylated ethylene imine, co-poly [(dimethylimino) trimethylene (dimethylimino) hexamethylene disalt], co-poly [(diethylimino) trimethylene (dimethylimino) trimethylene disalt], co-poly [(dimethylimino) 2-hydroxypropyl salt], co-polyquarternium-2, co-polyquarternium-17, and co-polyquarternium-18, as described in

the *International Cosmetic Ingredient Dictionary*, 5th Edition, edited by J. A. Wenninger and G. N. McEwen, which is incorporated herein by reference. Other cationic monomers include those containing cationic sulfonium salts such as co-poly-1-[3-methyl-4-(vinylbenzyloxy)phenyl] tetrahydrothiophenium chloride. Especially preferred monomers are mono- and di-quaternary derivatives of methacrylamide. The counterion of the cationic co-monomer can be selected from, for example, chloride, bromide, iodide, hydroxide, phosphate, sulfate, hydrosulfate, ethyl sulfate, methyl sulfate, formate, and acetate.

**[00138]** Examples of monomers that are cationic on protonation include, but are not limited to, acrylamide, N,N-dimethylacrylamide, N,N di-isopropylacrylamide, N-vinylimidazole, N-vinylpyrrolidone, ethyleneimine, dimethylaminohydroxypropyl diethylenetriamine, dimethylaminoethylmethacrylate, dimethylaminopropylmethacrylamide, dimethylaminoethylacrylate, dimethylaminopropylacrylamide, 2-vinyl pyridine, 4-vinyl pyridine, 2-vinyl piperidine, 4-vinylpiperidine, vinyl amine, diallylamine, methyldiallylamine, vinyl oxazolidone; vinyl methyloxazolidone, and vinyl caprolactam.

**[00139]** Monomers that are cationic on protonation typically contain a positive charge over a portion of the pH range of 2-11. Such suitable monomers are also presented in *Water-Soluble Synthetic Polymers: Properties and Behavior*, Volume II, by P. Molyneux, CRC Press, Boca Raton, 1983, ISBN 0-8493-6136. Additional monomers can be found in the *International Cosmetic Ingredient Dictionary*, 5th Edition, edited by J. A. Wenninger and G. N. McEwen, The Cosmetic, Toiletry, and Fragrance Association, Washington D.C., 1993, ISBN 1-882621-06-9. A third source of such monomers can be found in *Encyclopedia of Polymers and Thickeners for Cosmetics*, by R. Y. Lochhead and W. R. Fron, Cosmetics & Toiletries, vol. 108, May 1993, pp 95-135. All three references are incorporated herein.

**[00140]** Examples of acidic monomers that are capable of forming an anionic charge in the composition include, but are not limited to, acrylic acid, methacrylic acid, ethacrylic acid, dimethylacrylic acid, maleic anhydride, succinic anhydride, vinylsulfonate, cyanoacrylic acid, methylenemalononic acid, vinylacetic acid, allylacetic acid, ethylideneacetic acid, propylideneacetic acid, crotonic acid, fumaric acid, itaconic acid, sorbic acid, angelic acid, cinnamic acid, styrylacrylic acid, citraconic acid, glutaconic

acid, aconitic acid, phenylacrylic acid, acryloxypropionic acid, citraconic acid, vinylbenzoic acid, N- vinylsuccinamidic acid, mesaconic acid, methacroylalanine, acryloylhydroxyglycine, sulfoethyl methacrylate, sulfopropyl acrylate, and sulfoethyl acrylate. Preferred acid monomers also include styrenesulfonic acid, 2-methacryloyloxymethane-1-sulfonic acid, 3- methacryloyloxypropane-1- sulfonic acid, 3-(vinyl oxy)propane-1-sulfonic acid, ethylenesulfonic acid, vinyl sulfuric acid, 4-vinylphenyl sulfuric acid, ethylene phosphonic acid and vinyl phosphoric acid. Most preferred monomers include acrylic acid, methacrylic acid and maleic acid. The copolymers useful in this invention may contain the above acidic monomers and the alkali metal, alkaline earth metal, and ammonium salts thereof.

**[00141]** Examples of monomers having an uncharged hydrophilic group include but are not limited to vinyl alcohol, vinyl acetate, vinyl methyl ether, vinyl ethyl ether, ethylene oxide and propylene oxide. Especially preferred are hydrophilic esters of monomers, such as hydroxyalkyl acrylate esters, alcohol ethoxylate esters, alkylpolyglycoside esters, and polyethylene glycol esters of acrylic and methacrylic acid.

**[00142]** Finally, examples of uncharged hydrophobic monomers include, but are not limited to, C<sub>1</sub>-C<sub>4</sub> alkyl esters of acrylic acid and of methacrylic acid.

**[00143]** The copolymers are formed by copolymerizing the desired monomers. Conventional polymerization techniques can be employed. Illustrative techniques include, for example, solution, suspension, dispersion, or emulsion polymerization. A preferred method of preparation is by precipitation or inverse suspension polymerization of the copolymer from a polymerization media in which the monomers are dispersed in a suitable solvent. The monomers employed in preparing the copolymer are preferably water soluble and sufficiently soluble in the polymerization media to form a homogeneous solution. They readily undergo polymerization to form polymers which are water-dispersable or water-soluble. The preferred copolymers contain acrylamide, methacrylamide and substituted acrylamides and methacrylamides, acrylic and methacrylic acid and esters thereof. Suitable synthetic methods for these copolymers are described, for example, in Kirk-Othmer, *Encyclopedia of Chemical Technology*, Volume 1, Fourth Ed., John Wiley & Sons.

**[00144]** Other examples of polymers that provide the sheeting and anti-spotting benefits are polymers that contain amine oxide hydrophilic groups. Polymers that contain other hydrophilic groups such as a sulfonate, pyrrolidone, and/or carboxylate groups can also be used. Examples of desirable poly-sulfonate polymers include polyvinylsulfonate, and more preferably polystyrene sulfonate, such as those sold by Monomer-Polymer Dajac (1675 Bustleton Pike, Feasterville, Pa. 19053). A typical formula is as follows:

$[\text{CH}(\text{C}_6\text{H}_4\text{SO}_3\text{Na})-\text{CH}_2]_n-\text{CH}(\text{C}_6\text{H}_5)-\text{CH}_2$  wherein  $n$  is a number to give the appropriate molecular weight as disclosed below.

**[00145]** Typical molecular weights are from about 10,000 to about 1,000,000, preferably from about 200,000 to about 700,000. Preferred polymers containing pyrrolidone functionalities include polyvinyl pyrrolidone, quaternized pyrrolidone derivatives (such as Gafquat 755N from International Specialty Products), and copolymers containing pyrrolidone, such as polyvinylpyrrolidone/dimethylaminoethylmethacrylate (available from ISP) and polyvinyl pyrrolidone/acrylate (available from BASF). Other materials can also provide substantivity and hydrophilicity including cationic materials that also contain hydrophilic groups and polymers that contain multiple ether linkages. Cationic materials include cationic sugar and/or starch derivatives and the typical block copolymer detergent surfactants based on mixtures of polypropylene oxide and ethylene oxide are representative of the polyether materials. The polyether materials are less substantive, however.

**[00146]** Preferred polymers comprise water-soluble amine oxide moieties. It is believed that the partial positive charge of the amine oxide group can act to adhere the polymer to the surface of the surface substrate, thus allowing water to "sheet" more readily. To the extent that polymer anchoring promotes better "sheeting" higher molecular materials are preferred. Increased molecular weight improves efficiency and effectiveness of the amine oxide-based polymer. The preferred polymers of this invention have one or more monomeric units containing at least one N-oxide group. At least about 10%, preferably more than about 50%, more preferably greater than about 90% of said monomers forming said polymers contain an amine oxide group. These polymers can be described by the general formula:  $\text{P}(\text{B})$  wherein each  $\text{P}$  is selected from homopolymerizable and copolymerizable moieties which attach to form the polymer

backbone, preferably vinyl moieties, e.g. C(R)<sub>2</sub>--C(R)<sub>2</sub>, wherein each R is H, C<sub>1</sub>-C<sub>12</sub> (preferably C<sub>sub.1</sub>-C<sub>sub.4</sub>) alkyl(ene), C<sub>6</sub>-C<sub>12</sub> aryl(ene) and/or B; B is a moiety selected from substituted and unsubstituted, linear and cyclic C<sub>1</sub>-C<sub>12</sub> alkyl, C<sub>1</sub>-C<sub>12</sub> alkylene, C<sub>1</sub>-C<sub>12</sub> heterocyclic, aromatic C<sub>6</sub>-C<sub>12</sub> groups and wherein at least one of said B moieties has at least one amine oxide group present; u is from a number that will provide at least about 10% monomers containing an amine oxide group to about 90%; and t is a number such that the average molecular weight of the polymer is from about 2,000 to about 500,000, preferably from about 5,000 to about 250,000, and more preferably from about 7,500 to about 200,000. Preferred polymers also include poly(4-vinylpyridine N-oxide) polymers (PVNO), wherein the average molecular weight of the polymer is from about 2,000 to about 500,000 preferably from about 5,000 to about 400,000, and more preferably from about 7,500 to about 300,000. In general, higher molecular weight polymers are preferred. Often, higher molecular weight polymers allow for use of lower levels of the wetting polymer, which can provide benefits in floor cleaner applications. The desirable molecular weight range of polymers useful in the present invention stands in contrast to that found in the art relating to polycarboxylate, polystyrene sulfonate, and polyether based additives, which prefer molecular weights in the range of 400,000 to 1,500,000. Lower molecular weights for the preferred poly-amine oxide polymers of the present invention are due to greater difficulty in manufacturing these polymers in higher molecular weight.

[00147] Some non-limiting examples of homopolymers and copolymers which can be used as water soluble polymers of the present invention are: adipic acid/dimethylaminohydroxypropyl diethylenetriamine copolymer; adipic acid/epoxypropyl diethylenetriamine copolymer; polyvinyl alcohol; methacryloyl ethyl betaine/methacrylates copolymer; ethyl acrylate/methyl methacrylate/methacrylic acid/acrylic acid copolymer; polyamine resins; and polyquaternary amine resins; poly(ethenylformamide); poly(vinylamine) hydrochloride; poly(vinyl alcohol-co-6% vinylamine); poly(vinyl alcohol-co-12% vinylamine); poly(vinyl alcohol-co-6% vinylamine hydrochloride); and poly(vinyl alcohol-co-12% vinylamine hydrochloride). Preferably, said copolymer and/or homopolymers are selected from the group consisting of adipic acid/dimethylaminohydroxypropyl diethylenetriamine copolymer; poly(vinylpyrrolidone/ dimethylaminoethyl methacrylate); polyvinyl alcohol; ethyl

acrylate/methyl methacrylate/ethacrylic acid/acrylic acid copolymer; methacryloyl ethyl betaine/methacrylates copolymer; polyquaternary amine resins; poly(ethenylformamide); poly(vinylamine) hydrochloride; poly(vinyl alcohol-co-6% vinylamine); poly(vinyl alcohol-co-12% vinylamine); poly(vinyl alcohol-co-6% vinylamine hydrochloride); and poly(vinyl alcohol-co-12% vinylamine hydrochloride).

**[00148]** Polymers useful in the present invention can be selected from the group consisting of copolymers of hydrophilic monomers. The polymer can be linear random or block copolymers, and mixtures thereof. The term "hydrophilic" is used herein consistent with its standard meaning of having affinity for water. As used herein in relation to monomer units and polymeric materials, including the copolymers, "hydrophilic" means substantially water soluble. In this regard, "substantially water soluble" shall refer to a material that is soluble in distilled (or equivalent) water, at 25° C., at a concentration of about 0.2% by weight, and are preferably soluble at about 1% by weight. The terms "soluble", "solubility" and the like, for purposes hereof, correspond to the maximum concentration of monomer or polymer, as applicable, that can dissolve in water or other solvents to form a homogeneous solution, as is well understood to those skilled in the art.

**[00149]** Nonlimiting examples of useful hydrophilic monomers are unsaturated organic mono- and polycarboxylic acids, such as acrylic acid, methacrylic acid, crotonic acid, maleic acid and its half esters, itaconic acid; unsaturated alcohols, such as vinyl alcohol, allyl alcohol; polar vinyl heterocyclics, such as, vinyl caprolactam, vinyl pyridine, vinyl imidazole; vinyl amine; vinyl sulfonate; unsaturated amides, such as acrylamides, e.g., N,N-dimethylacrylamide, N-t-butyl acrylamide; hydroxyethyl methacrylate; dimethylaminoethyl methacrylate; salts of acids and amines listed above; and the like; and mixtures thereof. Some preferred hydrophilic monomers are acrylic acid, methacrylic acid, N,N-dimethyl acrylamide, N,N-dimethyl methacrylamide, N-t-butyl acrylamide, dimethylamino ethyl methacrylate, thereof, and mixtures thereof.

**[00150]** Polycarboxylate polymers are those formed by polymerization of monomers, at least some of which contain carboxylic functionality. Common monomers include acrylic acid, maleic acid, ethylene, vinyl pyrrolidone, methacrylic acid, methacryloylethylbetaine, etc. Preferred polymers for substantivity are those having higher molecular weights. For example, polyacrylic acid having molecular weights below about



10,000 are not particularly substantive and therefore do not normally provide hydrophilicity for three rewettings with all compositions, although with higher levels and/or certain surfactants like amphoteric and/or zwitterionic detergent surfactants, molecular weights down to about 1000 can provide some results. In general, the polymers should have molecular weights of more than about 10,000, preferably more than about 20,000, more preferably more than about 300,000, and even more preferably more than about 400,000. It has also been found that higher molecular weight polymers, e.g., those having molecular weights of more than about 3,000, 000, are extremely difficult to formulate and are less effective in providing anti-spotting benefits than lower molecular weight polymers. Accordingly, the molecular weight should normally be, especially for polyacrylates, from about 20,000 to about 3,000,000; preferably from about 20,000 to about 2,500,000; more preferably from about 300,000 to about 2,000,000; and even more preferably from about 400,000 to about 1, 500,000.

**[00151]** Non limiting examples of polymers for use in the present invention include the following: poly(vinyl pyrrolidone/acrylic acid) sold under the name "Acrylidone"® by ISP and poly(acrylic acid) sold under the name "Accumer"® by Rohm & Haas. Other suitable materials include sulfonated polystyrene polymers sold under the name Versaflex® sold by National Starch and Chemical Company, especially Versaflex 7000. The level of polymeric material will normally be less than about 0.5%, preferably from about 0.001% to about 0.4%, more preferably from about 0.01% to about 0.3%. In general, lower molecular weight materials such as lower molecular weight poly(acrylic acid), e.g., those having molecular weights below about 10,000, and especially about 2,000, do not provide good anti-spotting benefits upon rewetting, especially at the lower levels, e.g., about 0.02%. One should use only the more effective materials at the lower levels. In order to use lower molecular weight materials, substantivity should be increased, e.g., by adding groups that provide improved attachment to the surface, such as cationic groups, or the materials should be used at higher levels, e.g., more than about 0.05%.

### **Nanoparticles**

**[00152]** Nanoparticles, defined as particles with diameters of about 400 nm or less, are technologically significant, since they are utilized to fabricate structures, coatings, and

devices that have novel and useful properties due to the very small dimensions of their particulate constituents. "Non-photoactive" nanoparticles do not use UV or visible light to produce the desired effects. Nanoparticles can have many different particle shapes. Shapes of nanoparticles can include, but are not limited to spherical, parallelepiped-shaped, tube shaped, and disc or plate shaped.

**[00153]** Nanoparticles with particle sizes ranging from about 2 nm to about 400 nm can be economically produced. Particle size distributions of the nanoparticles may fall anywhere within the range from about 1 nm, or less, to less than about 400 nm, alternatively from about 2 nm to less than about 100 nm, and alternatively from about 2 nm to less than about 50 nm. For example, a layer synthetic silicate can have a mean particle size of about 25 nanometers while its particle size distribution can generally vary between about 10 nm to about 40 nm. Alternatively, nanoparticles can also include crystalline or amorphous particles with a particle size from about 1, or less, to about 100 nanometers, alternatively from about 2 to about 50 nanometers. Nanotubes can include structures up to 1 centimeter long, alternatively with a particle size from about 1 nanometer, or less, to about 50 nanometers. Nanoparticles can be present from 0.01 to 1%.

**[00154]** Inorganic nanoparticles generally exist as oxides, silicates, carbonates and hydroxides. These nanoparticles are generally hydrophilic. Some layered clay minerals and inorganic metal oxides can be examples of nanoparticles. The layered clay minerals suitable for use in the coating composition include those in the geological classes of the smectites, the kaolins, the illites, the chlorites, the attapulgites and the mixed layer clays. Smectites include montmorillonite, bentonite, pyrophyllite, hectorite, saponite, sauconite, nontronite, talc, beidellite, volchonskoite and vermiculite. Kaolins include kaolinite, dickite, nacrite, antigorite, anauxite, halloysite, indellite and chrysotile. Illites include bravaisite, muscovite, paragonite, phlogopite and biotite. Chlorites include corrensite, penninite, donbassite, sudoite, pennine and clinocllore. Attapulgites include sepiolite and polygorskyte. Mixed layer clays include alleverdite and vermiculitebiotite. Variants and isomorphic substitutions of these layered clay minerals offer unique applications.

**[00155]** The layered clay minerals suitable for use in the coating composition may be either naturally occurring or synthetic. An example of one embodiment of the coating

composition uses natural or synthetic hectorites, montmorillonites and bentonites.

Another embodiment uses the hectorites clays commercially available. Typical sources of commercial hectorites are LAPONITE® from Southern Clay Products, Inc., U.S.A.; Veegum Pro and Veegum F from R. T. Vanderbilt, U.S.A.; and the Barasyls, Macaloids and Propaloids from Baroid Division, National Read Comp., U.S.A.

**[00156]** The inorganic metal oxides used in the coating composition may be silica- or alumina-based nanoparticles that are naturally occurring or synthetic. Aluminum can be found in many naturally occurring sources, such as kaolinite and bauxite. The naturally occurring sources of alumina are processed by the Hall process or the Bayer process to yield the desired alumina type required. Various forms of alumina are commercially available in the form of Gibbsite, Diaspore, and Boehmite from manufacturers such as Condea.

**[00157]** Synthetic hectorites, such as LAPONITE RD®, do not contain any fluorine. An isomorphous substitution of the hydroxyl group with fluorine will produce synthetic clays referred to as sodium magnesium lithium fluorosilicates. These sodium magnesium lithium fluorosilicates, marketed as LAPONITE B® and LAPONITE S®, contain fluoride ions of greater than 0% up to about 8%, and preferably about 6% by weight. LAPONITE B® particles are flat disc-shaped, or plate shaped, and have a mean particle size of about 40 nanometers in diameter and about 1 nanometer in thickness. Another variant, called LAPONITE S®, contains about 6% of tetrasodium polyphosphate as an additive. In some instances, LAPONITE B® by itself is believed, without wishing to be bound to any particular theory, to be capable of providing a more uniform coating (that is, more continuous, i. e., less openings in the way the coating forms after drying), and can provide a more substantive (or durable) coating than some of the other grades of LAPONITE® by themselves (such as LAPONITE RD®).

**[00158]** The aspect ratio for disk shaped nanoparticles is the ratio of the diameter of the clay particle to that of the thickness of the clay particle. The aspect ratio of individual particles of LAPONITE® B is approximately 40 and the aspect ratio of individual particles of LAPONITE® RD is approximately 25. A high aspect ratio is desirable for film formation of nanosized clay materials. More important to the invention is the aspect ratio of the dispersed particles in a suitable carrier medium, such as water. The aspect

ratio of the particles in a dispersed medium can be considered to be lower where several of the disc shaped particles are stacked on top of one another than in the case of individual particles. The aspect ratio of dispersions can be adequately characterized by TEM (transmission electron microscopy).

**[00159]** LAPONITE B® occurs in dispersions as essentially single clay particles or stacks of two or fewer clay particles. The LAPONITE RD® occurs essentially as stacks of two or more single clay particles. Thus, the aspect ratio of the particles dispersed in the carrier medium can be dramatically different from the aspect ratio of single disc-shaped particle. The aspect ratio of LAPONITE B® is about 20-40 and the aspect ratio of LAPONITE RD® is less than 15.

**[00160]** In some preferred embodiments, the nanoparticles will have a net excess charge on one of their dimensions. For instance, flat plate-shaped nanoparticles may have a positive charge on their flat surfaces, and a negative charge on their edges. Alternatively, such flat plate-shaped nanoparticles may have a negative charge on their flat surfaces and a positive charge on their edges. Preferably, the nanoparticles have an overall net negative charge. This is believed to aid in hydrophilizing the surface coated with the nanoparticles. The amount of charge, or "charge density", on the nanoparticles can be measured in terms of the mole ratio of magnesium oxide to lithium oxide in the nanoparticles. In preferred embodiments, the nanoparticles have a mole ratio of magnesium oxide to lithium oxide of less than or equal to about 11%.

**[00161]** Depending upon the application, the use of variants and isomorphous substitutions of LAPONITE® provides great flexibility in engineering the desired properties of the coating composition used in the present invention. The individual platelets of LAPONITE® are negatively charged on their faces and possess a high concentration of surface bound water. When applied to a hard surface, the hard surface is hydrophilically modified and exhibits surprising and significantly improved wetting and sheeting, quick drying, uniform drying, anti-spotting, anti-soil deposition, cleaner appearance, enhanced gloss, enhanced color, minor surface defect repair, improved smoothness, anti-hazing properties, modification of surface friction, reduced damage to abrasion and improved transparency properties. In addition, the LAPONITE® modified surface exhibits "self-cleaning" properties (dirt removal via water rinsing, e.g. from

rainwater) and/or soil release benefits (top layers are strippable via mild mechanical action).

**[00162]** In contrast to hydrophilic modification with organic polymers, the benefits provided by nanoparticles, such as LAPONITE®, either alone or in combination with a charged modifier, are longer lived. For example, sheeting/anti-spotting benefits are maintained on an automobile body and glass window after multiple rinses versus the duration of such benefits after only about one rinse with tap water or rainwater on a surface coated with hydrophilic polymer technology.

### **Substances Generally Recognized As Safe**

**[00163]** Compositions according to the invention may comprise substances generally recognized as safe (GRAS), including essential oils, oleoresins (solvent-free) and natural extractives (including distillates), and synthetic flavoring materials and adjuvants. Compositions may also comprise GRAS materials commonly found in cotton, cotton textiles, paper and paperboard stock dry food packaging materials (referred herein as substrates) that have been found to migrate to dry food and, by inference may migrate into the inventive compositions when these packaging materials are used as substrates for the inventive compositions.

**[00164]** Suitable GRAS materials are listed in the Code of Federal Regulations (CFR) Title 21 of the United States Food and Drug Administration, Department of Health and Human Services, Parts 180.20, 180.40 and 180.50, which are hereby incorporated by reference. These suitable GRAS materials include essential oils, oleoresins (solvent-free), and natural extractives (including distillates). The GRAS materials may be present in the compositions in amounts of up to about 10% by weight, preferably in amounts of 0.01 and 5% by weight.

**[00165]** Preferred GRAS materials include oils and oleoresins (solvent-free) and natural extractives (including distillates) derived from alfalfa, allspice, almond bitter (free from prussic acid), ambergris, ambrette seed, angelica, angostura (cusparia bark), anise, apricot kernel (persic oil), asafetida, balm (lemon balm), balsam (of Peru), basil, bay leave, bay (myrcia oil), bergamot (bergamot orange), bois de rose (Aniba rosaeodora Ducke), cacao, camomile (chamomile) flowers, cananga, capsicum, caraway, cardamom

seed (cardamon), carob bean, carrot, cascarilla bark, cassia bark, Castoreum, celery seed, cheery (wild bark), chervil, cinnamon bark, Civet (zibeth, zibet, zibetum), ceylon (Cinnamomum zeylanicum Nees), cinnamon (bark and leaf), citronella, citrus peels, clary (clary sage), clover, coca (decocainized), coffee, cognac oil (white and green), cola nut (kola nut), coriander, cumin (cummin), curacao orange peel, cusparia bark, dandelion, dog grass (quackgrass, triticum), elder flowers, estragole (esdragol, esdragon, estragon, tarragon), fennel (sweet), fenugreek, galanga (galangal), geranium, ginger, grapefruit, guava, hickory bark, horehound (hoarhound), hops, horsemint, hyssop, immortelle (Helichrysum augustifolium DC), jasmine, juniper (berries), laurel berry and leaf, lavender, lemon, lemon grass, lemon peel, lime, linden flowers, locust bean, lupulin, mace, mandarin (Citrus reticulata Blanco), marjoram, mate, menthol (including menthyl acetate), molasses (extract), musk (Tonquin musk), mustard, naringin, neroli (bigarade), nutmeg, onion, orange (bitter, flowers, leaf, flowers, peel), origanum, palmarosa, paprika, parsley, peach kernel (persic oil), pepper (black, white), peanut (stearine), peppermint, Peruvian balsam, petitgrain lemon, petitgrain mandarin (or tangerine), pimenta, pimenta leaf, pipsissewa leaves, pomegranate, prickly ash bark, quince seed, rose (absolute, attar, buds, flowers, fruit, hip, leaf), rose geranium, rosemary, saffron, sage, St. John's bread, savory, schinus molle (Schinus molle L), sloe berries, spearmint, spike lavender, tamarind, tangerine, tarragon, tea (Thea sinensis L.), thyme, tuberose, turmeric, vanilla, violet (flowers, leaves), wild cherry bark, ylang-ylang and zedoary bark.

**[00166]** Suitable synthetic flavoring substances and adjuvants are listed in the Code of Federal Regulations (CFR) Title 21 of the United States Food and Drug Administration, Department of Health and Human Services, Part 180.60, which is hereby incorporated by reference. These GRAS materials may be present in the compositions in amounts of up to about 1% by weight, preferably in amounts of 0.01 and 0.5% by weight.

**[00167]** Suitable synthetic flavoring substances and adjuvants that are generally recognized as safe for their intended use, include acetaldehyde (ethanal), acetoin (acetyl methylcarbinol), anethole (parapropenyl anisole), benzaldehyde (benzoic aldehyde), n-Butyric acid (butanoic acid), d- or l-carvone (carvol), cinnamaldehyde (cinnamic aldehyde), citral (2,6-dimethyloctadien-2,6-al-8, gera-nial, neral), decanal (N-decylaldehyde, capraldehyde, capric aldehyde, caprinaldehyde, aldehyde C-10), ethyl

acetate, ethyl butyrate, 3-Methyl-3-phenyl glycidic acid ethyl ester (ethyl-methyl-phenyl-glycidate, so-called strawberry aldehyde, C-16 aldehyde), ethyl vanillin, geraniol (3,7-dimethyl-2,6 and 3,6-octadien-1-ol), geranyl acetate (geraniol acetate), limonene (d-, l-, and dl-), linalool (linalol, 3,7-dimethyl-1,6-octadien-3-ol), linalyl acetate (bergamol), methyl anthranilate (methyl-2-aminobenzoate), piperonal (3,4-methylenedioxy-benzaldehyde, heliotropin) and vanillin.

**[00168]** Suitable GRAS substances that may be present in the inventive compositions that have been identified as possibly migrating to food from cotton, cotton textiles, paper and paperboard materials used in dry food packaging materials are listed in the Code of Federal Regulations (CFR) Title 21 of the United States Food and Drug Administration, Department of Health and Human Services, Parts 180.70 and 180.90, which are hereby incorporated by reference. The GRAS materials may be present in the compositions either by addition or incidentally owing to migration from the substrates to the compositions employed in the invention, or present owing to both mechanisms. If present, the GRAS materials may be present in the compositions in amounts of up to about 1% by weight.

**[00169]** Suitable GRAS materials that are suitable for use in the invention, identified as originating from either cotton or cotton textile materials used as substrates in the invention, include beef tallow, carboxymethylcellulose, coconut oil (refined), cornstarch, gelatin, lard, lard oil, oleic acid, peanut oil, potato starch, sodium acetate, sodium chloride, sodium silicate, sodium tripolyphosphate, soybean oil (hydrogenated), talc, tallow (hydrogenated), tallow flakes, tapioca starch, tetrasodium pyrophosphate, wheat starch and zinc chloride.

**[00170]** Suitable GRAS materials that are suitable for use in the invention, identified as originating from either paper or paperboard stock materials used as substrates in the invention, include alum (double sulfate of aluminum and ammonium potassium, or sodium), aluminum hydroxide, aluminum oleate, aluminum palmitate, casein, cellulose acetate, cornstarch, diatomaceous earth filler, ethyl cellulose, ethyl vanillin, glycerin, oleic acid, potassium sorbate, silicon dioxides, sodium aluminate, sodium chloride, sodium hexametaphosphate, sodium hydrosulfite, sodium phosphoaluminate, sodium silicate,

sodium sorbate, sodium tripolyphosphate, sorbitol, soy protein (isolated), starch (acid modified, pregelatinized and unmodified), talc, vanillin, zinc hydrosulfite and zinc sulfate.

## **Water**

**[00171]** When the cleaning composition is an aqueous composition, water can be, along with the solvent, a predominant ingredient. The water should be present at a level of less than 99.9%, or less than about 99%, or less than about 98%. Deionized water is preferred.

## **Method of Use**

**[00172]** The substrate can be used for cleaning, disinfectancy, or sanitization on inanimate, household surfaces, including floors, counter tops, furniture, windows, walls, and automobiles. Other surfaces include stainless steel, chrome, and shower enclosures. The substrate may be used as a wet or dry wipe. The substrate may be used as a dry or wet mitt or glove. The substrate can be packaged individually or together in soft packs, canisters, tubs, etc. The package may contain information printed on said package comprising an instruction to use the more abrasive side to remove soil followed by using the less abrasive side to wipe the soil away. The substrate can be used with the hand, or as part of a cleaning implement. The cleaning implement may be a manual tool or a motorized tool. Examples of suitable cleaning implements include a hard surface floor mop, a carpet mop, a toilet cleaning device, a bathroom cleaning device, and a shower cleaning device. Examples of suitable cleaning implements using a disposable cleaning substrate include U.S. Pat. 6,611,986 to Seals, WO00/71012 to Belt et al., U.S. Pat. App. 2002/0129835 to Pieroni and Foley, and WO00/27271 to Policicchio et al. In any of these uses, the substrate may be used impregnated with a cleaning solution. In any of these uses, the substrate may be used dry. In any of these uses, the substrate may be used dry in combination with a cleaning solution. In any of these uses, the substrate may be used "dry to the touch" with an impregnated cleaning solution.

**[00173]** Additionally, the present invention includes a system comprising the cleaning substrate and information that will inform the consumer, by written or spoken words and/or by pictures, that use of the cleaning substrate will remove tough or hard-to-remove soils. Accordingly, the use of packages in association with information that will



inform the consumer, by words and/or by pictures, that use of the cleaning substrate will provide benefits such as, but not limited to, improved scrubbing is important. The information can include, e.g., advertising in all of the usual media, as well as statements and icons on the package, or on the cleaning substrate itself, to inform the consumer of the unique tough soil removal capabilities. The information may be communicated only by verbal means, only by written means, only by pictorial means, or any combination thereof. Information can be provided in a form of written instructions placed on or in packaging for the cleaning substrate, on the cleaning substrate itself, or on a separate article (such as, but not limited to, a piece of paper) packaged with the cleaning substrate. Obviously, the information need not be included directly with the product to constitute a system within this aspect of the invention. That is, for example, if a cleaning substrate is sold and advertisements are communicated generally about the cleaning substrate, this would constitute a system of this invention.

### **EXAMPLES**

**[00174]** Disposable cleaning substrates (Examples A-D) in Table I were prepared with a distinct top layer and a distinct bottom layer using airlaid techniques with cellulosic fiber (pulp), bicomponent fiber (Bico) and high denier thermoplastic polyester fiber (PET). A latex binder ( $T_g = +5^{\circ}\text{C}$ ) was applied to bind the substrate together.

**[00175]** Mop pads were formed by combining the disposable cleaning substrate cover layer (Examples A-D) with a pulp/bicomponent (Bico) fiber absorbent layer (250 gsm comprising 84% pulp fiber, 9% bicomponent fiber, and 7% of a polypropylene carrier layer) and a polyethylene (PE) film backsheet. Mop pads from Examples B and D, with 15 denier and 6 denier fibers respectively gave mopping removal of shoe scuff marks in approximately 30% fewer strokes compared to the Comparative Example, which was formed using one layer spunlaced techniques. The mop pads from Examples B and D also had significantly higher absorbent capacity compared to the Comparative Example pads.

**[00176]**

**[00177]**      **Table I**

	Top layer nonwoven	Bottom layer nonwoven	Total substrate
Example A 1.0 mm caliper	15 gsm PET (88%) (15 denier) 2 gsm Bico (12%)	40 gsm pulp (89%) 5 gsm Bico (11%)	8 gsm latex (11%) 40 gsm pulp (57%) 15 gsm PET (21%) 7 gsm Bico (10%)
Example B 1.0 mm caliper	5 gsm pulp (23%) 15 gsm PET (68%) (15 denier) 2 gsm Bico (9%)	40 gsm pulp (89%) 5 gsm Bico (11%)	8 gsm latex (11%) 45 gsm pulp (60%) 15 gsm PET (20%) 7 gsm Bico (9%)
Example C 1.0 mm caliper	15 gsm PET (88%) (6 denier) 2 gsm Bico (12%)	40 gsm pulp (89%) 5 gsm Bico (11%)	8 gsm latex (11%) 40 gsm pulp (57%) 15 gsm PET (21%) 7 gsm Bico (10%)
Example D 1.0 mm caliper	5 gsm pulp (23%) 15 gsm PET (68%) (6 denier) 2 gsm Bico (9%)	40 gsm pulp (89%) 5 gsm Bico (11%)	8 gsm latex (11%) 45 gsm pulp (60%) 15 gsm PET (20%) 7 gsm Bico (9%)
Comparative Example			8 gsm latex (10%) 50 gsm rayon (63%) (1.5 denier) 22 gsm PET (27%) (1.5 denier)

**[00178]**      The disposable cleaning substrates (Examples E-H) in Table II were formed as unitized substrates combining the cover layer with the absorbent layer in one step.

**[00179]**      Table II

	Top layer nonwoven	Bottom layer nonwoven	Total substrate
Example E 2.5 mm caliper	15 gsm PET (75%) (15 denier) 5 gsm Bico (25%)	2 layers of 92 gsm pulp (90%) 10 gsm Bico(10%)	8 gsm latex (3%) 184 gsm pulp (79%) 15 gsm PET (6%) 25 gsm Bico (11%)
Example F 2.0 mm caliper	15 gsm PET (75%) (6 denier) 5 gsm Bico (25%)	2 layers of 75 gsm pulp (90%) 8 gsm Bico(10%)	8 gsm latex (4%) 150 gsm pulp (77%) 15 gsm PET (8%) 21 gsm Bico (11%)
Example G 2.0 mm caliper	5 gsm pulp (20%) 15 gsm PET (60%) (6 denier) 5 gsm Bico (20%)	2 layers of 75 gsm pulp (90%) 8 gsm Bico(10%)	8 gsm latex (4%) 155 gsm pulp (78%) 15 gsm PET (8%) 21 gsm Bico (11%)
Example H 2.5 mm caliper	5 gsm pulp (20%) 15 gsm PET (60%) (15 denier) 5 gsm Bico (20%)	2 layers of 92 gsm pulp (90%) 10 gsm Bico(10%)	8 gsm latex (3%) 189 gsm pulp (80%) 15 gsm PET (6%) 25 gsm Bico (11%)

**[00180]**      The coefficient of friction (static) and coefficient of friction (kinetic) was measured for Examples B, D and DD(which was prepared as D and then further embossed) and compared to the Comparative Example in Table III. The coefficients of static and kinetic friction were measured using INDA Standard Test: IST 140.1 (01), using a Thwing-Albert EJA Series Tensile Tester, Part No. 1750-2001. The machine settings were: Test Distance = 130 mm, Static Filter = 15.0 mm, Sled weight = 200 g, Test speed = 150 mm/min. The samples were cut to 4"X 9" with the 4" in the Machine Direction and the 9" length being the Cross Direction of the material to be tested. The material was placed on the apparatus to where the 9" length is in the direction of the test method. The coefficient of friction slide will be pulled along the Machine Direction of the material. A Carver Auto Series Hydraulic Press was used to emboss the Example DD (Model 3895.2PROA00). An aluminum die with the engraved emboss pattern was placed on the bottom platen of the press. The platen was heated to 160C. The pressure on the press was set to 20,000 lbs. The dwell time was set to 1 minute. The material was cut to 12" X 12" and placed on the die in between the two platens of the press. The press was then used to the specifications above.

**[00181]**            Table III

	Coefficient of Friction Static	Coefficient of Friction Kinetic	Ratio of coefficients
Comparative Example	0.539	0.381	1.41
Example B	0.653	0.447	1.46
Example D	0.700	0.441	1.59
Example DD Embossed	0.678	0.443	1.53

**[00182]**            The disposable cleaning substrates were measured for MD tensile strength, % MD elongation, CD tensile strength, % CD elongation, and % Squeeze Out in Table IV. ASTM Standard D5034 – 95 (INDA Standard Test: IST 110.1) Changed Machine settings to: Speed = 12 in/min, Gauge length = 4 inches, all others according to standard.

**[00183]**                            Table IV

	MD Tensile g/in	% MD Elongation	CD Tensile g/in	% Elongation	% Squeeze Out
Example A	59	58	336	46	61
Example B	737	27	459	28	72
Example C	1168	30	648	30	71
Example D	986	28	670	26	67
Example H MTS008	1698	25	1446	63	78

**[00184]**            The disposable cleaning substrates were measured for absorbency rate (Time in seconds to absorb 10 ml of deionized water) in Table V.

**[00185]**            Absorbency Rate test method.

Place sample (4.5" X 11") to be tested on counter top with absorbent side up. Place insult plate (¼" thick acrylic plate 6" X 12"; 2.0 cm diameter hole cut in the center as insult point with a 2" high and 1" ID tube sealed over insult point to contain the fluid) on top of sample. Measure 10 mL of DI water (with blue food coloring) in 100 ml graduated cylinder. Pour 10 mL of DI water into sample through insult top on the plate. Start

stopwatch as soon as fluid comes in contact with the sample. Stop stopwatch when fluid has been absorbed completely into sample. This is done by looking into the tube as it is being absorbed. Measure the time in seconds as Absorbency Time 1. Wait 1 minute and repeat steps 4-6 four more times. Measure times as Absorbency Time 1 – 5 respectively.

[00186]

Table V

	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Comparative Example	1.97	2.55	3.67	4.39	5.00
Example B	2.88	4.58	4.87	5.29	5.95
Example D	2.09	2.48	2.77	2.85	3.09

[00187] The disposable cleaning substrates (Examples A-D) were combined with absorbent layers and backsheet layers. The absorbent layer was 250 gsm comprising 84% pulp fiber, 9% bicomponent fiber, and 7% of a polypropylene carrier layer. The substrates were measured for total absorbency, thickness, basis weight, bulk density, and wet weight in Table VI. Finally, their performance on scuff mark removal was compared a Comparative Example.

[00188] Total Absorbency “Dunk and Drain” Method

Weigh 4” X 4” samples dry = Dry wt. Place samples in container (large enough to completely immerse samples) with DI water for 5 minutes. Remove from DI water with tongs or tweezers and clip on corner with the suspended binder clip. Allow sample to drain while suspended for 5 minutes. Record sample weight after 5 minutes = Wet wt. Calculations: Total Absorbency in g/g = (Wet wt – Dry wt.)/ Wet wt.

[00189]

Table VI

	Total Absorbency g/g	Thickness mm	Basis Weight	Bulk Density g/cc	Wet weight	Strokes to Scuff Mark Removal
Comparative Pad	7.14	2.89	348.1	0.12	29.24	107
Example A plus absorbent and backsheet layer	7.58	3.59	373.3	0.10	33.04	24
Example B plus absorbent and backsheet layer	8.84	3.33	369.4	0.11	37.51	33
Example C plus absorbent and backsheet layer	8.61	3.50	379.4	0.11	37.63	21
Example D plus absorbent and backsheet layer	9.02	3.48	375.23	0.11	38.80	35

[00190] The disposable cleaning substrates (Examples E-H) were formed as unitized substrates. They were measured for total absorbency, thickness, basis weight, bulk density, and wet weight in Table VII.

[00191]

Table VII

	Unitized Total Absorbency g/g	Thickness mm	Basis Weight	Bulk Density g/cc	Wet weight
Comparative Unitized pad	7.14	2.89	348.10	0.12	29.24
Example E	15.40	3.81	236.7	0.06	40.06
Example F	15.15	3.66	216.7	0.06	36.11
Example G	15.49	3.62	199.9	0.06	34.03
Example H	14.75	3.72	257.4	0.07	41.85

[00192]

Additional examples of the invention are given in Table VII.

[00193]

Table VII

	Top layer nonwoven	Bottom layer nonwoven	Total substrate
Example I	1 gsm pulp (6%) 15 gsm PET (88%) (2 denier) 1 gsm Bico (6%)	40 gsm pulp (98%) 1 gsm Bico (2%)	8 gsm latex <sup>a</sup> (12%) 41 gsm pulp (62%) 15 gsm PET (23%) 2 gsm Bico (3%)
Example J	5 gsm pulp (23%) 15 gsm PET (68%) (9 denier) 2 gsm Bico (9%)	40 gsm pulp (89%) 5 gsm Bico (11%)	8 gsm latex <sup>b</sup> (11%) 45 gsm pulp (60%) 15 gsm PET (20%) 7 gsm Bico (9%)
Example K	15 gsm PET (88%) (25 denier) 2 gsm Bico (12%)	40 gsm pulp (89%) 5 gsm Bico (11%) 2 gsm superabsorbent <sup>c</sup>	8 gsm latex (11%) 40 gsm pulp (56%) 15 gsm PET (21%) 7 gsm Bico (10%) 2 gsm superabsorbent(3%)

a. abrasive latex from National Starch and Chemical (Nacrylic ABX-30-25331A).

b. RESYN 1072 (Tg=+37<sup>0</sup>C) from National Starch and Chemical.

c. DRYTECH® 2035LD from Dow Chemical Co.

[00194]

Without departing from the spirit and scope of this invention, one of ordinary skill can make various changes and modifications to the invention to adapt it to various usages and conditions. As such, these changes and modifications are properly, equitably, and intended to be, within the full range of equivalence of the following claims.